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CREATIVE THINKING IN ART STUDENTS, THE PROCESS OF DISCOVERY.
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A SYSTEMATIC EXPLORATION OF THE COGNITIVE PROCESSES INVOLVED IN THE PRODUCTION OF A DRAWING WAS CONDUCTED. A SITUATION WAS DESIGNED IN WHICH A SAMPLE GROUP OF ABOUT 30 ARTISTS COULD BE OBSERVED AT WORK. BEHAVIOR WAS RECORDED AND THE PROGRESS OF THEIR WORK PHOTOGRAPHED. OF THE BEHAVIORS OBSERVED, SIX WERE TAKEN TO REFLECT RELEVANT STAGES IN THE FORMULATION AND SOLUTION OF DISCOVERED PROBLEMS. THESE PROCESS VARIABLES INCLUDED--(1) MANIPULATION OF OBJECTS, (2) SELECTION OF UNUSUAL OBJECTS, (3) EXPLORATORY BEHAVIOR, (4) OPENNESS OF PROBLEM STRUCTURE, (5) DISCOVERY-ORIENTED BEHAVIOR, AND (6) CHANGES IN PROBLEM STRUCTURE AND CONTENT. ON THE BASIS OF FINDINGS, THE INVESTIGATORS CONCLUDED THAT THE IDENTIFICATION OF SOME OF THE ELEMENTS IN THE PROCESS OF DISCOVERY IN PROBLEM-SOLVING SHOULD FACILITATE THE COMPARATIVE STUDY OF ACTUAL CREATIVE PROCESSES ACROSS VARIOUS FIELDS OF ENDEAVOR. (WB)

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Cooperative Research Project No. S-080

Jacob W. Getzels
and
Mihaly Csikszentmihalyi

THE UNIVERSITY OF CHICAGO
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The study also provided the data for the doctoral dissertation of Mr. Mihaly Csikszentmihalyi, in which aspects of the problems dealt herein are further developed. The present report draws heavily on this work.

J.W.G.

M.C.

TABLE OF CONTENTS

Page

LIST OF TABLES iv

LIST OF ILLUSTRATIONS vi

Chapter

I. INTRODUCTION 1

II. PROCEDURES 7

III. RESULTS I: THE NATURE OF DISCOVERED PROBLEM-SOLVING PROCESSES 15

IV. RESULTS II: ANALYSIS OF THE RELATIONSHIPS BETWEEN PROCESS AND PRODUCT IN DISCOVERED PROBLEM SOLVING 39

V. RESULTS III: THE DISCOVERERS--AN ANALYSIS OF SOME PERSONAL CONCOMITANTS OF DISCOVERY ORIENTATION 54

VI. RESULTS IV: EXPLORATIONS OF THE PERCEPTUAL PROCESSES OF ARTISTS 71

VII. RESULTS V: CONSISTENCY OF ARTISTIC JUDGMENTS . . 81

VIII. SUMMARY AND CONCLUSIONS 94

REFERENCES 102

LIST OF TABLES

Table		Page
2.01	Type and Characteristics of Objects Used as Stimuli for the Discovered Problem-Solving Task .	9
3.01	Discovery Process Scores for All Subjects	28
3.02	Scoring Reliability of Process Variables (2 raters)	29
3.03	Correlations among sub-Totals and the Total Discovery Process Score	31
3.04	Correlation Matrix of 10 Discovery Variables, Three Sub-Totals, and One Total Discovery Process Score	33
4.01	Correlations between Ratings Given by Five Artists to 31 Drawings	43
4.02	Correlation between Total Ratings Give by Five Artists to 31 Drawings	43
4.03	Correlations between the Ratings of Five Artists on Three Dimensions of Evaluation, and the Discovery Process Variables Observed in the Experiment	46
4.04	Zero and First-Order Partial Correlations between the Process Scores and the Product Ratings . . .	48
4.05	Second-Order Partial Correlations between the Ratings of the Products and Performance on "Presented" and "Discovered" Problems	49
5.01	Mean Scores of High and Low Discoverers on Three Cognitive Instruments	55
5.02	Correlations between Discovery Process Variables and Cognitive Test Performance	56
5.03	Performance on the Vigotsky Test: Art Students vs. Norms	58
5.04	Correlations between Variables Measuring Discovered and Presented Problem-Solving Performance	58
5.05	Correlations between Discovery Process Variables and Artistic Performance in School	60

5.06 Number of Extra-Scholastic Shows and Exhibits Participated in By High and Low Discoverers . . . 60

5.07 Age at Which Subjects Began to Do Art-Work in Excess of School Requirements 61

5.08 TAT "Novelty of Production" Scores of High and Low Discoverers 63

5.09 TAT "Discovery" and "Humor" Content of Stories Written in Response to Slide #3--Scored by Two Raters 64

5.10 "Financial Concern" and "Alienation" Content of Stories Written in Response to TAT Slide #3--Scored by Two Raters 66

5.11 Sibling Position of High and Low Discoverers . . . 66

5.12 Income of Parents on High and Low Discoverers . . . 67

6.01 A Comparison of Art Students with Norms on Percentage Responses Given in Various Standard Rorschach Categories--Normative Data from Beck et al., 1950, p. 296 74

6.02 Correlation of Intelligence Scores with Percentage of Rorschach Responses Determined by Form and Color Independently, and in Combination 77

6.03 Correlation of Relative Frequency in Two Rorschach Response Categories, with the Discovery Process Variables and the Product Ratings 80

7.01 Agreement within Four Groups of Judges Rating 31 Drawings on Three Dimensions, Expressed by Intraclass Correlation Coefficients 85

7.02 Correlations among the Averaged Ratings of the Three Dimensions of Evaluation, for the Four Groups of Judges 87

7.03 First-Order Partial Correlations among the Averaged Ratings of the Three Dimensions of Evaluation 87

7.04 Correlations between the Averaged Ratings of the Four Groups of Judges, on the Three Dimensions of Evaluation 88

7.05 Average Ratings Given to "Realistic" and to "Abstract" Drawings 89

LIST OF ILLUSTRATIONS

Figure		Page
4.01	Scattergram Illustrating the Relationship between the Total Discovery Process Score and the Product Ratings by Five Artists on Originality .	47a
7.01	Over-all Aesthetic Ratings of Four Selected Drawings--an Illustration of Different Patterns of Consistency	91

CHAPTER I

INTRODUCTION

The work being reported attempted to explore the cognitive processes involved in artistic creation. Specifically, three central issues were posed: (1) Could the manifest behavior observed in artistic composition be classified systematically? (2) Assuming this could be done, could differences among artists in this respect be described reliably? (3) Assuming this, would there be any relationship between these descriptions and (a) the quality of the aesthetic products, and (b) selected intellective and personalistic characteristics of the artists?

In our preceding companion investigation (Getzels and Csikszentimihalyi, 1964) it became apparent that although cognitive variations could be observed in the manner in which different artists approached their work, existing instruments did not provide systematic and reliable measures of the felt variations. A thorough review of the literature, reported in the preceding study, suggested that the lack of adequate measures might be due to the absence of a basic theoretical framework for making such observations. Although Guilford (1963, 1965) and others had begun mapping aspects of the "structure of intellect" presumably necessary for artistic creation, and Beittel and Burkhart (1963), and Beittel (1964) have approached painting as a unique type of problem solving, systematic concepts and clear-cut categories for ordering observations with respect to creative and non-creative processes were still inadequate, if not lacking altogether.

The same study (Getzels and Csikszentmihalyi, 1964, p. 118) suggested that a fundamental difference between the two processes might lie in the domain not of solving problems as had hitherto been supposed but in formulating problems. That is, the difference between the creative and the non-creative process was that the latter dealt essentially with problems that had already been formulated and needed only to be solved, while the former dealt essentially with problems that had not been previously formulated. It is in effect the new problem without as yet the possibility of solution rather than the new solution made possible by an already existing question that is the mark of originality. A similar distinction has recently been made by MeWorth (1965) who differentiated problem-solving and problem-finding, and concluded that "more than ever, men are needed to define the unexpected problem" (p. 54). It is from this general point of view that we undertook to explore the cognitive processes of artists in an actual creative situation.

The Concept of Discovered and Presented Problem Solving

What is the relationship between creating a novel cognitive composition and solving a given cognitive problem? How, for example, is "thinking up" a new pattern related to "putting together" an old one? More broadly, how is the creative process related to the more usual cognitive processes? Our basic hypothesis is that perhaps the most significant element, and the element that seems to have been largely overlooked, is the envisagement of the creative question. Beginning with this hypothesis, Getzels (1964) developed a formal model relating various types of problem-solving situations from the most to the least "creative" ones. The model suggests that problematic situations can be classified along a continuum between two extremes: *presented problem situations* and *discovered problem situations*. In the former, the problem is already formulated, there is a known method of solution and a known (correct) solution exists. In the latter, the problem does not have a known formulation, and therefore there is neither a known method of solution nor a previously known solution (Getzels, 1964, p. 241). Within the two extremes it is possible to distinguish several types of problematic situations varying in what is known and unknown. As an illustration, let O in Fig. 1 stand for "other" (i.e., teacher, experimenter, society), P for "person" (i.e., subject, student, problem-solver), + for what is "known," and - for what is "unknown" (Getzels and Csikszentmihalyi, 1964, p. 118).

Type Case	Problem Formulation		Method of Solution		Solution	
	O	P	O	P	O	P
1.	+	+	+	+	+	-
2.	-	+	+	-	+	-
3.	-	-	-	-	-	-

Fig. 1.--A Typology of Problem-Solving Situations

The three examples in Fig. 1 obviously do not exhaust the possibilities of the model. Taking Type-case 1 as an instance, the problem consists in plugging the specific data into a given formula to find an already known correct solution in a finite number of steps. This is essentially a problem in *retrieval*. To investigate this process there are, among others, the concepts and methods of the associationists to lean on. In Typ-case 2, the problem is again known or given, but the method as well as the solution are unknown to the problem-solver, although both are known to others. In this case the process is one of reasoning rather than retrieval, and for its study one can use, among others, the conceptual framework of Gestalt psychology. In Type-case 3, the problem itself must be formulated before a method towards its solution can be contemplated, and when the solution is obtained, there is no immediate criterion as to its ultimate correctness. Here the process goes beyond both retrieval and reasoning; an attempt at inventiveness, at "going beyond available information" must be made. The problem-solver must participate in the process of discovery (Getzels and Csikszentmihalyi, 1964, p. 119).

The crucial issue for understanding the creative process then becomes: How are these new or reconstructed problems formulated by the creative person? It is this envisagement of the fruitful problem, as well as the achievement of the consequent new solution, that the present study will begin to investigate.

An Experimental Application of the Concept of Discovered Problem Solving to Artistic Creativity

The present study was designed to observe, describe, and analyze the performance of a group of subjects involved in a discovered problem solving situation. The subjects were senior-level art students at the School of the Art Institute of Chicago, many of whom have already achieved professional distinction as artists. The specific discovered problem situation was one in which the subjects were given the opportunity of producing a drawing that they would consider an "artistic work."

There were at least three good reasons why this sample and task were selected for study in order to gain insight into discovered problem solving. In the first place, creativity is a meaningful and relevant issue for a group of art students, some of whom were by almost any criterion already "artists." Central in their past training and future goals is the achievement of creative products. Second, each time an artist embarks on the creation of an artistic work, he becomes involved, to a greater or lesser extent, by our definition, in discovered as against presented problem solving. There is ideally no restriction on the problem he may deal with nor any precedent for the solution upon which he may arrive. What does vary is the amount of discovery he brings to the task. And third, in artistic production the creative process, at least in its manifest aspects, can be observed more easily than in other creative domains such as say the writing of poetry.

The Specific Research Questions of the Study

In order to provide a starting point for the understanding of the structure of discovered problem solving processes, the present study will attempt to answer the following questions:

1. Methodology

    a. Is it possible to replicate a discovered problem solving process in an experimental situation?

    b. Can differences in discovered problem solving styles be observed in the Ss' behavior?

    c. Can categories of analysis relevant to discovery be established from the Ss' interview answers?

    d. Is concern for discovery as measured by self-report related to discovery-oriented behavior?

2. Validity

   a. Do styles of performance in discovered problem solving relate to the quality of the product, as rated by proressional artists?

   b. Is the distinction between "presented" and "discovered" problem-solving strategies supported by the data?

   c. Do styles of performance in discovered problem solving relate to other cognitive and personalistic variables?

Question #1 above will be dealt with in Chapter III of this report, question #2 is discussed in Chapters IV and V. In addition, we will deal with two important issues that emerged during the course of the investigation. In Chapter VI, some findings related to the artists' perceptual styles, as revealed by the Rorschach, will be discussed. In Chapter VII, the issue of reliability in rating art-work will be explored.

CHAPTER II

PROCEDURES

The Sample

The universe from which the sample was drawn consisted of 35 male third and fourth year students, majoring in Fine Arts at the School of the Art Institute of Chicago. These students had participated in an extensive exploratory research one year prior to the beginnings of the present study. A thorough description of the group can be found in Getzels and Csikszentmihalyi (1964).

Of the 35 students originally available, 33 took part in the current research. Two Ss were used as pilot cases before the procedures became formalized; these Ss were dropped from the sample, which consequently has an N of 31.

If the size of the sample is modest, its quality is remarkably suited for the purposes of this study. In the first place, all Ss have been admitted to, and survived at least three years in, one of the most prestigious Art schools in the country, thus giving proof of relatively high professional skills. Second, by majoring in the Fine Arts, as against Art Education or Advertising Art which are also available in the School, they have shown strong motivation to pursue the free-lance career of creative artists, despite the insecurity that such a choice implies. They are committed to Art. Finally, several Ss in the sample are at least partially dependent for their income on their artistic production. Some have standing contracts with recognized art galleries; some have exhibited in one-man shows or won prizes in group exhibits. Accordingly, it may be expected that in such a select sample the probability of observing manifestations of genuine artistic creativity are greater than it would be in vastly larger samples of "normal" subjects.

Experimental Procedures

The discovered problem-solving task

The main body of findings in this study is based on data obtained from observations of the discovered problem-solving process described below.

Setting, instructions, and procedure.--The Ss were introduced, one at a time, into a studio-room at the Art Institute. The room contained two tables and several chairs. On Table A, 27 objects were arranged; the arrangement was kept exactly the same for each S. The objects, which ranged from very simple to very complex, are listed in Table 2.01. Table B was empty, except for the drawing implements provided for the experiment. When the S entered the room, the Experimenter read the following instructions:

> "There is a variety of objects on this table (Table A).
> I am asking you to choose some of them, rearrange them any way you please on this other table (Table B), and draw them with the materials provided over there.
> The important thing is that the drawing should be pleasing to you.
> You may choose as many objects as you want.
> You may spend as much time as you want selecting the objects and drawing them. However, it would be best if you could finish this task within an hour.
> Are there any questions?"

If there were questions, they were answered by placing emphasis on the freedom of the situation, i.e.: "You can do whatever you

TABLE 2.01

TYPE AND CHARACTERISTICS OF OBJECTS USED AS STIMULI FOR THE DISCOVERED PROBLEM-SOLVING TASK

Name	Type*	Complexity*
Manikin	Human	Medium
Doll	Human	Complex
Statuette	Human	Complex
Elm branch	Organic	Complex
Grapes, white	Organic	Medium
Grapes, black	Organic	Medium
Gourd (1)	Organic	Simple
Gourd (2)	Organic	Simple
Gourd (3)	Organic	Simple
Optical glass	Organic	Complex
Baseball glove	Utensil	Medium
Woman's hat	Utensil	Medium
Book	Utensil	Simple
Horn	Utensil	Complex
Marracas	Utensil	Medium
Pitcher, pewter	Utensil	Medium
Pitcher, brass	Utensil	Medium
Pipe	Utensil	Simple
Silk fabric	Utensil	Medium
Carburetor	Mechanical	Complex
Gear	Mechanical	Complex
Chrome hood-lift	Mechanical	Complex
"Space Spider"	Abstract	Complex
Sphere	Abstract	Simple
Prism	Abstract	Simple
Circular lens	Abstract	Simple
Cylindrical lens	Abstract	Simple

*The objects were categorized as to type and complexity by six raters, with 98 and 85 per cent agreement, respectively.

want, as long as the drawing will be pleasing to you." All Ss understood the requirements at the first reading of the instructions, and very few needed even minor clarifications. Some Ss asked more precise indications about the length of time they should take for the drawing; such questions were answered with: "You can draw for five minutes or five hours, as long as you are pleased with your drawing." In general, the main concern of the Experimenter was to make the Ss feel at ease, and to duplicate as closely as possible a free painting situation. To this effect the Experimenter had coffee with almost every S before the experiment began, during which time a very informal relationship was established. Throughout the experiment such informality was maintained.

After the Ss understood the instructions, they began immediately to inspect and select the stimulus objects. This stage of the process took from 20 seconds to 6 minutes (mean 2'45", s.d. 1'51"). Then the selected objects were rearranged by the Ss on Table B; time spent arranging ranged between 20 seconds and slightly over 10 minutes (mean 2'41", s.d. 2'56"). The actual drawing time ranged between 7 minutes for the fastest student, and two hours and 18 minutes for the slowest, with a mean of 41'55" and a s.d. of 23'59".

From the moment the instructions were read to the time each Ss finished his drawing, the Experimenter kept a record of the Ss' behavior. The record focussed on the following items:

1. Number, kind, and sequence of objects manipulated by S.
2. Type of manipulatory activity (feels weight, texture; moves parts of objects; superimposes; etc.).

3. Number and kind of objects selected by S.
4. Procedures used by S in arranging objects.
5. Behavior during drawing (i.e., type of media used, how often interrupts drawing, whether he rearranges objects, etc.).
6. Time employed to select, arrange, and draw objects.
7. Any unusual, unexpected behavior.

Furthermore, photographs of the Ss' work were taken at the following intervals: at 3, 6, and 9 minutes after drawing began, and at 6 minute intervals thereafter. The pictures were taken with available light, in order not to disturb the Ss with the glare of flash-bulbs.

Choice of stimulus objects.--The 27 objects among which Ss could select were intended to represent a broad range of possible types. A record was kept of the number and types of objects manipulated and chosen by the subject.

On the average, each S manipulated 7 objects and selected 4 to draw (mean 4.19, s.d. 1.92). The objects most often selected were: the _book_ (selected by 12 Ss), the _gear_ (11), _horn_, _brass pitcher_, _sphere_ (10 each). Least often selected were the _branch_, _glass_, _marracas_ (by 2 Ss each), the two _lenses_ (1 S each), and the _space spider_ which was never selected.

Drawing materials.--The following media were available for drawing:

1. Bristol board, size 15" x 23"
2. Oak-tack drawing paper, size 18" x 25"
3. Pencils of various hardness
4. Hard and soft charcoal sticks
5. 24 color pastels

The interview

Following the completion of the drawing, the Ss were interviewed in the same studio where the experiment took place. Fifteen questions covering items of interest for this study were asked of each S. The main purpose of the interview was to obtain information about the Ss' subjective view of the process of discovery, in terms which could be related to the Experimenter's observations. Some of the questions were: (1) "Why did you pick up object X?" (4) "Why did you arrange the objects as you did?" (6) "What meaning does the drawing have for you?" (9) "What were you thinking while you were choosing the objects?" and so forth. Beside specific answers to these questions, Ss often volunteered additional miscellaneous information. The Experimenter wrote out the answers in long-hand; thus some loss of material occurred in the recording. Interviews lasted from half an hour to over two hours.

The presented task

In order to observe the Ss' approach to the solution of a "presented" task, the Vigotsky concept formation test was administered upon completion of the interview. The reason for choosing this test is two-fold. In the first place, it is a performance test of the type which measures the ability to arrive at a single correct solution, as opposed to the main experiment, where no previously known solutions are available. Second, the cognitive steps involved in the formulation and solution of the Vigotsky problem can be inferred from the Ss' behavior, in a way which is somewhat analogous to the behavioral inferences that can be made about the process of solution of the "discovered" experimental task. Instructions and scoring procedures were adopted from Hanfmann and Kasanin (1942, pp. 49-54). Performance on this test lasted from less than 2 minutes to more than 45 minutes.

The Rorschach test

Rorschach protocols were collected and analyzed for 28 of the 31 Ss. For a description of the methods of administration and scoring, see Chapter VI.

Additional information

A large amount of additional data collected in a previous study was on file for each S. A thorough description as well as the origins of these tests are given in Getzels and Csikszentmihalyi (1964, pp. 22-30). The following will be mentioned in this study:

Cognitive tests

a. Wonderlic Intelligence test
b. 16 P.F. Intelligence Factor
c. Unusual Uses
d. Brick Flexibility
e. Thing Categories (Ideational Fluency)

Scores on the three instruments c, d, and e above have been combined into a single "divergent thinking" score.

Personality tests

a. Allport-Vernon-Lindzey Study of Values
b. Sixteen Personality Factors Questionnaire
c. Thematic Apperception Test (group administration)

Ratings

Combined ratings on Originality and Artistic Potential, averaged from scores given by four teachers of a two-year period. These ratings are on file at the School of the Art Institute.

Grades

Average based on all grades received in Art courses. Obtained from the School files. Range: "F" = 0, to "A" = 12.

General information

Personal and family structure data obtained by means of a questionnaire.

Evaluation of products

The drawings were evaluated by five well-known fine artists, and rated on three dimensions: Craftsmanship, Originality, and Over-all Aesthetic Value.At a later time, the same drawings were rated by three other groups of judges: five art teachers at the School of the Art Institute of Chicago; five graduate students in mathematics and five graduate business students at the University of Chicago.

CHAPTER III

RESULTS I: THE NATURE OF DISCOVERED PROBLEM-SOLVING PROCESSES

How do artists "create" a work of art? There are many levels on which this question could be answered, and depending on the viewpoint and methods adopted, the answers would be different. Here we have focussed our interest on those aspects of the creative process which seemed to be analogous with cognitive processes of a "discovered" kind. The main issue raised in this study is whether "discovery" is a fruitful concept to use in connection with artistic creativity. To begin with, do artists during creative work behave in a way which suggests discovery orientation? If so, what are these behaviors, and how do artists differ on them? And do the artists mention discovery as a goal of their work when describing what they were trying to do? The first part of this chapter will deal with these questions. In the second part, the discovery-related variables described in the first section will be quantified in order to develop a measure of the discovery process; the reliability and internal consistency of the measure will be examined. Once these goals are accomplished--that is, discovery is operationally defined and reliably measured--we will be able to explore in subsequent chapters the question as to whether its presence or absence is related to any qualitative variation in the solutions to the problem and to any of the known intellective and personalitic characteristics of the artists.

Part I: Description of the Process of Artistic Problem Solving

Suitability of the experiment for measuring creative processes

The first question raised in the Introduction was whether it is possible to replicate something that can reasonably be called a "creative process" in an experimental setting. It is of course impossible to give an unequivocal answer to this question. There are, however, three lines of evidence which support the claim that the experiment, with all its limitations, did permit creative, or what we defined as "discovered," solutions to occur.

The first line of evidence is based on the Ss' self-reports, specifically on the answers to question #13 of the interview: "In what ways were your thoughts and working methods different in this experiment from your thoughts and methods when you work on your own?" Twenty-three Ss, or 72 per cent of the sample, answered that the difference, if any, was minimal. Four students compared the experiment with a classroom project rather than free painting. Only four Ss (14 per cent of the sample) reported that they had felt uncomfortable.

The second line of evidence is based on the argument that if the experiment did not allow 'discovery," there would have been little difference in the problem-solving behavior of the Ss. A "presented" problem in art would involve copying the available objects, and the process of copying should be very similar for all Ss. But as the following sections of this chapter will show, there were striking differences in the way the Ss formulated and attempted to solve the problem.

The third and final argument relies on experts' judgments of the products of the experiment. Four out of the five known artists who were asked to rate the drawings spontaneously expressed surprise at the generally high level of the products.

Therefore it can be said that the majority of Ss saw the experiment as a situation where they could work freely, that their behavior exhibited a range of experimentation and "discovery," and that many of the drawings produced were of high professional caliber. It is felt that these considerations permit the assumption--if for the present only an assumption--that the experiment did indeed permit the display of creative or discovered behavior on the Ss' part. Before going on to describe such behavior in the following sections, it should be noted that apparently the single major difference between the experiment and free creative work consists in the fact that the whole process of producing a work of art had been telescoped into one sitting. Many Ss have reported that they usually draw several sketches before the final drawing, or painting, can evolve. Changes from one sketch to the next could not be observed in the experiment, but this appears to be the chief if not the only difference between it and the free creative process.

Description of behavioral process variables

In order to gain information about the hypothesized role of discovery in creative production, two sources of data were available: the observation of artists' actual behavior while working, and the artists' answers to questions about their work. In this section we will describe some behaviors which on *a priori* grounds were deemed to be directed towards discovery, and which revealed large diffferences among the artists.

After the instructions were read, the Ss approached Table A to examine the array of objects. Some Ss touched as many as 19 objects while looking over the table, others touched only two. After examining the available objects, each S selected several which, after being re-arranged on Table B, constituted the nucleus out of which the drawing developed. Each object selected can be placed operationally on a "usualness-unusualness" continuum, depending on the frequency with which the object had been selected by the sample as a whole. Some Ss selected only very popular objects, others chose objects that no one else had selected. Finally, several Ss picked up the objects from Table A and placed them on Table B; others studied the objects before selecting them, felt their weight and texture, tried out their function, etc.

The three behaviors described above: manipulation of objects, selection of unusual objects, and exploratory behavior seemed to be all related to an orientation towards discovery. Moreover, their function appears to be that of facilitating the envisagement of the unknown problem. The more objects are manipulated, the greater the possibility of discovering among them new relationships, contrasting features, etc., and therefore of formulating a new problem. Perhaps this is why Torrance (1959, 1962) found manipulation of objects to be characteristic of creative children, and Henrickson (1963) noted a connection between it and the "aesthetic appeal" of children's drawings. Similarly, selection of more "unusual" objects may facilitate discovery of a problem by suggesting unthought of relationships and combinations. Finally, a thorough exploration of the objects may be expected to permit the discovery of previously hidden possibilities in the problematic elements--in the present case, the objects. The great variation the Ss showed in these three behaviors suggests that while all Ss were involved in discovery--they all had to find a problem--some tried to maximize the possibilities of the free situation, while others behaved almost as if they were confronted with a "presented" problem: they accepted the problematic elements at face value, without attempting to engage in discovery. We will later refer to the first group as that of the "high" discoverers, to the second as that of the "low" discoverers.

If the three variables described above seem to be relevant to the formulation of the discovered problem, the three that follow are instrumental to its solution. In the first place, the photographs recording the progress of each drawing show a wide variation in time when what the ultimate drawing will look like takes form. One drawing, for example, was already recognizable before 12 per cent of the total drawing time had elapsed, while another could not be recognized until 74 per cent of the drawing time had elapsed. Second, a great variety was noted in the Ss' behavior as they were drawing. Eleven Ss worked without interruption or change of media from the beginning of the task to the end. Others changed the medium or paper, and some moved around or substituted objects in the midst of drawing. And last, the final drawing of some Ss exactly duplicated the actual arrangement of objects on the table; that of others was completely unrecognizable from the original array.

The three variables above: openness of problem structure, discovery-oriented behavior while drawing, and changes in problem structure and content were assumed to measure varying elements of involvement with discovery at various stages of the problem solution. That creative problems should be kept "open" as long as possible has been observed by, among others, Biber (1959), and Beittel and Burkhart (1963). The lack of discovery-oriented behavior while drawing suggests that the S who works without changing his technique from beginning to end is more likely to fall back on a "known" method of solution, or a straightforward rendering in accordance with learned methods. And finally, a drawing that limits itself to reproducing the objects accurately deals by definition with "known" elements; the introduction of new relationships and new elements is more likely to result in discovery.

Description of self-report process variables

The six variables of behavior described above are though to reflect an orientation toward discovery on the artist's part. To determine whether this was also a conscious aim for the artists, their interviews were analyzed for evidence of concern with discovery.

The first step was to analyze the total interview for discovery-related content. Only the answers to interview questions #4, 10, and 11 were excluded from this analysis; these three questions will be dealt with independently below. Some remarkable differences emerged from the analysis. While 13 Ss very explicitly view their art-work as a seeking for understanding, as a literal discovery of laws and principles of reality, others are mainly concerned with expressing emotions or ideas; and 12 others think of their work as simply rendering reality albeit by transposing it from one spatial dimension to another.

The interview protocols can also be analyzed for signs of the Ss' concern with discovery in the experiment itself. A fruitful source of information was found in question #4 of the interview: "Why did you arrange the objects as you did?" Answers to this question reveal a great variety of approaches to the problem. The two extreme approaches were shown on the one hand by Ss who answered that they arranged the objects so that they could copy them exactly; on the other hand by Ss who claimed that the arrangement was completely arbitrary, and that they did not make any use of it: the real structuring of the solution occurred on the paper. In between these two extremes one finds Ss who arranged the objects so that they would suggest an abstract quality which they wanted to portray, such as movement, unity, or function.

Interview question #10 also lends itself to being analyzed for discovery content. "What were you thinking while you were drawing? What was your major concern?" The answers of some Ss show a great freedom in the solution of the problem. Their process of solution seems to rely on a feedback from the arrangement, but this becomes integrated with a central directing process (S.02: "I wasn't worried about the objects, but about the drawing. The work was corrected and developed in terms of what's in the mind . . ."). Accordingly, the drawing has a chance to develop into a new synthesis of external and internal reality. Others report that they were drawing "likeness" and "reproducing" the arrangement--an obviously presented approach to the solution.

Question #11 asked: "Could any of the elements in your drawing be eliminated without destroying its character?" Thirteen Ss answered "yes" to this question, the rest answered "no." The different answers seem to reflect the fact that for the first group of Ss the drawing is not a copy of some external arrangement; its structure can be changed, developed, and transformed without reference to an external "reality." The drawings of the other Ss cannot be changed without destroying their character, which consist in its similarity to the external arrangement; it's either "it" or nothing. Thus a "yes" answer to question #11 was also counted as a sign of concern with discovery in the problem solution.

Through this type of analysis the interviews were used to generate four variables related to discovery: _concern with discovery in general_, _concern with discovery in the formulation of the problem_, and two variables tapping _concern with discovery in the solution of the problem_, based on questions 10 and 11.

Part II: _Quantification of the Process Variables_

Scoring of discovery process variables

In the previous two sections some characteristics of the Ss' problem-solving processes were described. The description dealt with six behavioral and four self-report variables, all of which were assumed to reflect discovery orientation in the formulation and solution of the artistic problem.

The ten variables were then quantified in order to obtain an objective measure of the process of discovery. The three behaviors observed before the Ss began to draw were combined into a "Problem Formulation" sub-score. The three behaviors observed while the Ss were drawing yielded a "Problem-Solution" sub-score. The variables derived from the interviews were added to derive a "Concern with Discovery" sub-score. Finally, the process as a whole was summarized in a "Total Discovery Process Score." The present section will outline how the 10 individual scores and the various totals were obtained.

Problem Formulation

Number of objects manipulated (A1).--The score on this process-variable is a simple count of the different objects touched by a given S prior to the beginning of the drawing task. The count is based on the record taken during the experiment.

Unusual demand-quality of objects chosen (A2).--This score was based only on the objects selected by any given S and actually transferred by him from Table A to Table B. Each object was given a score, corresponding to the rank-order frequency with which it had been used by the sample as a whole. Thus the book, the most frequently chosen object in the experiment, was assigned a score of 1; the lens, chosen by the fewest Ss, had a score of 25.5. A S's score on this variable consisted of the averaged rank-score of all the objects he selected. The score was thus stabilized for the number of objects selected.

Discovery-oriented behavior during selection and arrangement (A3).--This variable was scored as follows. A score of 1 was given if the S just picked up the objects from Table A and placed them on Table B.[1] A score of 2 was given if the S was observed holding an object up to his eyes, if he felt its weight, texture, etc. A score of 3 was given if the S experimented with objects, for instance by looking through the prism and lens, changing the position of objects, trying to work mechanical parts, etc. A score of 5 was given when both 2 and 3 applied.

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[1] The numerical scores assigned to observed behaviors reflect the observer's a priori judgment as to the relative amount of discovery that a given behavior entails. Thus a behavior scored "3," is seen to require more discovery than a behavior scored "1," although not three times as much. In order to avoid influencing the results with arbitrary distortions due to the scoring system, the four composite discovery scores (see AA, BB, CC, and ABC below) are

Total Problem-Formulation score (AA).--Whenever a S was above the median for the sample on one of the three preceding variables, he was given a score of 1. By adding these scores the Total Problem-Formulation score was obtained. A constant 1 was added in order to give a numerical value to Ss who otherwise would have a zero score. The Total Problem-Formulation score has, therefore, a range of 1 to 4.

Problem Solution

Openness of problem-structure (B1).--To score this variable, the sequence of photographs taken during the experiment was examined. For each S, that photograph was scored which for the first time revealed the final structure of the drawing in all its essential elements. The score consisted in the number of minutes elapsed between the beginning of the experiment and the taking of the given picture, divided by the total time in minutes taken for the drawing as a whole. The score is, therefore, the percentage of the total drawing time elapsed before the final structure of the drawing was essentially completed.

Discovery-oriented behavior while drawing (B2).--Scored as follows: S gets a score of 1 if he just draws without interruption. Score 2 if he changes paper or switches from one medium to another. Score 3 if he changes the arrangement of objects, substitutes, or

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based on the number of times that a S was above the median for the group on any variable. Thus a very high score on one variable could not outweigh low scores on other variables.

manipulates objects. Score 5 if both 2 and 3 apply.

Changes in problem-structure and content (B3).--Score 1 if S just copies the arrangement. Score 2 if he introduces changes in perspective. Score 3 if he changes the relative magnitude of objects, or leaves one or more objects out. Score 4 if he changes the position of objects on the paper. Score 5 if there is an addition of non-existent objects or major visual elements. Score 9 if both 4 and 5 apply, etc.

Total Problem-Solution score (BB).--Whenever a S was above the median for the sample on one of the three preceding variables, he was given a score of 1. By adding these scores the Total Problem-Solution score was obtained. A constant 1 was added in order to give a numerical value to Ss who otherwise would have a zero score. The Total Problem-Solution score has, therefore, a range from 1 to 4.

Concern with discovery

Concern with discovery in general (C1).--Scored on the basis of the total interview protocol, exclusive of questions #4, 10, and 11. A score of 1 was given to each statement in the protocol that mentioned the S's interest in "discovery," "seeking for understanding," "quest for reality," "curiosity," "wanting to know," etc. Scores ranged from 0 to 4.

Concern with discovery in problem formulation (C2).--Scored on the basis of answers to interview question #4. A positive score of one was given each statement implying a lack of dependence on the arrangement. A negative score was given to statements indicating dependence on the arrangement. Scores ranged from -2 to +2.

After transformation into positive numbers, the range extended from 1 to 5.

Concern with discovery in problem-solution (C3).--Scores were based on answers to interview question #10. A positive score was given each statement implying a concern with developing the drawing above and beyond qualities directly suggested by the objects. A negative score was given to statements indicating that S's major concern while drawing was to copy the objects or qualities of the arrangement. Scores ranged from -2 to +3; adjusted range: 1 to 6.

Possibility of change (C4).--Score based on answer to interview question #11. An affirmative answer was scored 1, a negative answer 0.

Total Concern with Discovery score (CC).--When a S was above the median of the sample on one of the four preceding variables, he was given a score of 1. By adding these scores the Total Concern with Discovery score was obtained. A constant 1 was also added in order to give a numerical value to Ss who otherwise would have a zero score. The Total Concern with Discovery score, therefore, has a range of 1 to 5.

Total Discovery Process Score (ABC)

This score is the sum of the Total Problem-Formulation (4 scores), Total Problem-Solution (4 scores), and Total Concern with Discovery (5 scores) scores. It is therefore a global indicator of all the process variables measured. The highest score obtained was 13, indicating that the Ss were above the median on all ten process variables (13 - constant 3 = 10). The lowest score obtained was 3, which indicates that the particular S was below the median on all ten process variables.

Table 3.01 lists the individual scores for all subjects on the ten discovery variables, the three sub-totals, and on the Total Discovery Process.

Reliability in scoring the process variables

After the process variables had been scored according to the system outlined in the previous section, the records were given to an independent rater for re-scoring. As Table 3.02 indicates, the reliability obtained throughout was very high. The reliability in rating variable B1 (based on the sequence of process-shots) was established between three other independent raters.

It is to be noted that several ratings are not based on "primary sources." Variables A3, B2, C1, 2, 3 are scored from notes in the observational record or the report of the interview. Both of these were compiled by the observer and the error factor in his compilation is unknown. Reliability in recording the observations and the interviews was not collected for several reasons, among which the weightiest was that the presence of two observers might unduly disturb the Ss in their delicate task. However, most of the process variables used are of such self-evident nature that the recording should be accomplished with great reliability. Moreover, the Ss were tested at random, and the process variables finally selected for analysis are a few among the many recorded, so that bias on the part of the observer would play a negligible role.

TABLE 3.01

DISCOVERY PROCESS SCORES FOR ALL SUBJECTS

Subject Code No.	Problem Formulation				Problem Solution				Concern with Discovery					Total Discovery ABC
	A1	A2	A3	AA	B1	B2	B3	BB	C1	C2	C3	C4	CC	
01	10	9.1	5	4	47	2	5	4	3	2	2	1	5	13
02	6	7.7	3	3	46	2	3	4	2	2	2	0	4	11
03	8	8.5	2	3	28	2	2	3	0	-2	1	0	2	8
04	4	4.5	3	2	26	1	1	1	0	-1	-2	0	1	4
05	19	14.3	5	4	51	5	9	4	3	2	1	1	5	13
06	16	8.1	2	2	71	2	1	3	2	0	1	1	5	10
07	6	11.6	2	3	33	1	1	1	0	1	-1	0	2	6
08	6	9.4	2	3	29	5	7	3	0	1	1	1	4	10
09	5	4.0	1	1	21	1	1	1	0	-2	-1	0	1	3
10	2	4.5	1	1	47	1	1	2	0	-1	-1	1	2	5
11	19	9.7	3	4	74	1	9	3	2	0	1	1	5	12
12	7	8.3	3	3	11	2	1	2	3	-1	1	0	4	9
13	5	8.3	1	1	71	1	1	2	1	0	0	0	2	5
14	4	5.3	3	2	27	2	3	3	2	0	-1	0	3	8
15	4	2.8	1	1	31	2	2	3	1	0	1	0	3	7
16	4	9.5	3	3	35	3	7	3	2	1	-1	0	2	8
17	8	8.5	5	4	62	1	9	3	2	1	1	1	5	12
18	6	8.8	1	3	37	2	1	3	0	-2	0	0	1	7
19	3	6.8	1	1	45	2	1	3	4	-1	2	0	3	7
20	5	17.5	1	2	29	1	5	2	2	-1	0	1	3	7
21	8	4.4	2	2	41	2	3	4	0	-1	0	1	2	8
22	11	13.3	2	3	66	3	1	3	1	-1	-1	0	1	7
23	11	8.8	5	4	28	1	7	2	1	2	1	1	4	10
24	5	7.9	1	1	40	2	1	3	1	-2	-1	1	2	6
25	11	11.2	2	3	33	1	1	1	4	-1	-1	0	2	6
26	8	12.8	2	3	27	2	9	3	2	-1	2	1	4	10
27	15	11.2	3	4	55	2	1	3	0	-1	-1	0	1	8
28	3	4.0	2	1	33	2	1	2	0	1	-1	0	2	5
29	4	7.3	1	1	27	1	1	1	1	-1	3	0	2	4
30	5	5.0	2	1	11	5	9	3	0	1	1	1	4	8
31	2	11.[illegible]	3	3	42	5	6	4	0	1	0	1	2	10

TABLE 3.02

SCORING RELIABILITY OF PROCESS VARIABLES (2 raters)

	Placement Above or Below Median				Correlation Between Two Raters (product-moment)	
	Number of Agreements	Number of Disagreements	Chi^2	p Value	r.	p Value
Problem Formulation						
A1: No. objects manipulated	31	0	∞[a]	.....	...	.....[a]
A2: Unusualness of objects chosen	31	0	∞[a]	.....	...	.....[a]
A3: Exploratory behavior	27	4	18.0	<.0005	.82	<.0005
AA: Total	29	2	18.0	<.0005	.95	<.0005
Problem Solution						
B1: Openness of problem structure	...	...	....	.....	.86[b]	<.0005
B2: Exploratory approach to drawing	27	4	12.5	<.0005	.98	<.0005
B3: Change in problem-structure content	28	3	17.1	<.0005	.87	<.0005
BB: Total	29	2	19.9	<.0005	.86	<.0005
Concern with Discovery						
C1: In general	24	7	8.8	<.005	.79	<.0005
C2: In problem formulation	28	3	17.3	<.0005	.85	<.0005
C3: In problem solution	25	6	11.7	<.001	.74	<.0005
C4: Changes	31	0	∞[c]	.....	...	.....[c]
CC: Total	24	7	8.8	<.005	.70	<.0005
TOTAL DISCOVERY PROCESS	26	5	11.4	<.001	.89	<.0005

Note.--See top following page (page 30) for footnotes to this table.

Footnotes to Table 3.02

[a] These scores are actual counts of behavioral observations recorded during the experiments. Therefore, any lack of reliability could have occurred only while recording; however, the objective nature of the behavior recorded argues for high reliability.

[b] Median of six coefficients between three raters.

[c] This category is scored on the basis of a "yes" or "no" answer to a specific interview question.

In light of the above factors, the high correlations obtained argue in favor of the statement that the method for observing and scoring the process of discovery can be used reliably by any trained observer.

Relationships among process variables

The next question to be faced was: What are the relationships among the three measures of the discovery process? Does exploratory behavior as observed during the formulation of the problem correlate with the *Ss*' stated concern with discovery? Are both related to discovery-oriented attempts at solution?

It should be noted that the sources for the three measurements of discovery were completely independent. The problem-formulation variables include behaviors observed between the beginning of the experiment and the beginning of drawing. They do not overlap in time with the problem-solution variables, which were based on behaviors observed while the *Ss* were drawing. The concern with discovery variables are based on interview answers collected after the conclusion of the experiment. Finally, all the above variables were scored independently of each other, over a period of time.

If the concept of "discovered problem-solving process" is fruitful, the behaviors and subjective attitudes related to it ought to display a certain amount of consistency. As Table 3.03 indicates, the three independent measures are in fact significantly correlated for our sample. True, the coefficients obtained between the three measures although significant are not high, indicating that discovery oriented behavior at one stage of the process does not necessarily carry over to another. But it is certainly gratifying to note that discovery as manifested in behavior does relate to concern with discovery as measured in the interview. Moreover, the Total Discovery Process score correlates significantly with the component sub-scores and may be held, at least tentatively, as a quite stable index of the processes measured; problem formulation, solution, and attitude towards discovery.

TABLE 3.03

CORRELATIONS AMONG SUB-TOTALS AND THE TOTAL DISCOVERY PROCESS SCORE (N=31)

	1.	2.	3.	4.
1. Problem-formulation total (AA)	-	.34*	.38**	.74***
2. Problem solution total (BB)		-	.42**	.72***
3. Concern with discovery total (CC)			-	.83***
4. Total discovery process (ABC)				-

*P. = .05 **p. = .025 ***p. = .001

Note.--The correlations between the three sub-totals and the grand total (column 4) are inflated due to the effect known as "spurious overlap." In the present case, this means that each sub-total contributes approximately 30 per cent of the grand total's variance so that even in the absence of any correlation between the sub-total and the other two, the *rho* between one sub-total and the grand total would still be .55. Recently Henrysson (1963) developed a formula to correct *rhos* for spurious overlap. The formula is not applicable in the present case, nor is it methodologically expedient. For our purposes, the important fact is that the "total discovery process score" should be representative of all three stages of the process, and that it is.

Table 3.04 presents a more detailed view of the relationships between the 10 process variables, the three sub-totals, and the total discovery score. It is immediately apparent that all 10 variables are significantly correlated with the total discovery process score (row 14). While a few of these correlations, i.e., between A2, B1, B2, and ABC, are barely above what would be expected as a result of spurious overlap (see note to Table 3.03), most are very high. And again the important fact is that the total score is indeed representative of most of its sub-scores.

Another obvious point made by the table is that some variables are much better over-all predictors of the total pattern than others are. For instance, variable B3 (amount of change introduced in the problem) correlates significantly with seven of the remaining nine variables; A1 (number of objects manipulated) correlates significantly with six of the nine other variables. By contrast, B1 shows only one significant correlation.

Some of the interview variables show very high correlations with the measures of behavior. For instance, C2 (concern with discovery in the problem formulation) shows a *rho* of .68 with A3, .37 with B2, .55 with B3; it also correlates .39 and .34 with subtotals AA and BB. A factor analysis would probably extract one single homogeneous "discovery" factor comprising five or six of the ten variables. At this exploratory stage, it might be more useful to retain all our variables, keeping in mind that some more than others seem to have in common the hypothetical construct of "discovery."

The statistic employed to compute the strength of relation-

TABLE 3.04

CORRELATION MATRIX OF 10 DISCOVERY VARIABLES, THREE SUBTOTALS, AND ONE TOTAL DISCOVERY PROCESS SCORE (N=31)

			Problem Formulation				Problem Solution				Concern for Discovery					Total Discovery Process Score
			A1	A2	A3	AA	B1	B2	B3	BB	C1	C2	C3	C4	CC	ABC
Problem formulation	1.	A1	-													
	2.	A2	.44													
	3.	A3	.48	.22												
	4.	AA	.64	.60	.77											
Problem solution	5.	B1	.51	.24	.15	.25										
	6.	B2	.05	.14	.13	.13	-.11									
	7.	B3	.30	.34	.56	.48	.02	.44								
	8.	BB	.26	.14	.35	.34	.34	.58	.43							
Concern for discovery	9.	C1	.33	.32	.28	.23	.18	-.12	.14	.13						
	10.	C2	.17	.11	.68	.39	.14	.37	.55	.34	.14					
	11.	C3	.16	.11	.16	.14	.02	.13	.37	.34	.40	.27				
	12.	C4	.37	.18	.28	.19	.18	.14	.61	.32	.11	.24	.28			
	13.	CC	.44	.18	.55	.38	.18	.20	.66	.42	.54	.59	.65	.64		
Total discovery process score	14.	ABC	.59	.40	.74	.74	.32	.37	.70	.72	.43	.60	.52	.52	.83	

With N = 31, an r. of .30 is significant at the .05 level.
.36 is significant at the .025 level.
.48 is significant at the .005 level.
.57 is significant at the .0005 level.

ships is the product-moment correlation. As there might be some question whether the data satisfy the assumptions underlying this statistic, some of the correlations were tested with two other methods, neither one of which requires a normal distribution or equal scaling of intervals. As Table 3.05 indicates, the three methods yield quite similar results. The contingency coefficient (C) based on the Chi-square tends to give larger values when compared with *rho*. The values of the index of association (H, or Gamma) are not directly comparable to *rho* or C: an H of 42 means that one would do 42 per cent better than chance in predicting order on one variable from order on the other (among random pairs differing on both).[1] Values of H can vary, like those of *rho* between -1.00 and +1.00. An increment in prediction of 30 per cent over chance is customarily considered a sign of noteworthy relationship. The three methods of measuring correlations arrive at essentially identical results. Since it is a more usual and easier method, *rho* will be retained to report relationships.

TABLE 3.05

COMPARISON OF VALUES OBTAINED WITH THREE STATISTICS MEASURING CORRELATION

Variables Correlated	Product-moment Coefficient (same as in Table 3.04)	Contingnecy Coefficient (C)	Index of Association (H)
A1 and A2	.44	.47	.42
A1 and A3	.45	.48	.46
A2 and A3	.22	.37	.38
AA and BB	.34	.41	.41
AA and CC	.38	.69	.33
BB and CC	.42	.54	.33

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[1] J. A. Davis, "A Net Partial and a Multiple Coefficient for Goodman and Kruskal's Gamma," *Mimeo.*, NORC, Univ. of Chicago, October, 1964.

Summary and Conclusions

The study of creative problem-solving processes has so far been generally neglected by behavioral scientists. There are two basic reasons for such neglect: the difficulty of reproducing the creative process in an experimental setting, and the lack of a general theory which would suggest hypotheses and methods of investigation. One purpose of this study is to provide the beginnings of a theory and a method appropriate for dealing with this problem.

In the first place, an experimental situation was devised in which true-to-life creative processes could be observed. It has been shown that the majority of subjects approached the experiment as a situation in which they could freely work on a creative task. The task was seen by them as genuine and relevant to their usual work, rather than as a "test" or even a classroom project. Second, the concept of "discovered problem-solving" was adopted to generate hypotheses that could be applied to analyse the creative process.

The assumption on which the study rests is that creative processes are analogous to the process of discovered problem-solving. The purest form of discovery involves the formulation of a new problem, and its solution through previously unknown methods. Less innovative forms of discovery consist in the solution of a known problem through new methods, or the formulation of a new problem and its solution through known methods. Therefore, problem-solving processes can be assessed along a continuum of discovery, depending on the amount of "unknown" elements that are successfully integrated into the problem at various stages of the process.

In terms of the diagram presented in Chapter I, the Ss in this study could be divided essentially into two groups, as shown in Fig. 3.01. All Ss had to formulate an "unknown" problem, one that had no previous definition--although even at this point there are some quantitative differences between subjects, differences indicating that some tend to engage in more extensive discovery than others. When it comes to attempts at solution, the quantitative differences can be interpreted as becoming qualitative. For some Ss, it is impossible to predict how the drawing will develop by knowing the arrangement of objects. These artists continue the process of discovery in their attempts at solution: the resulting drawing will be an "unknown" quantity. The drawings of the other Ss are more or less exact copies of what they had formulated in the first step: these Ss reverted to a presented method of solution, one that does not require discovery after the problem has been formulated. When the process is perceived in its totality, from the envisagement of the problem to its solution, we see that the first type of artist (whom from now on we shall call "high" discoverers) tend to work at the pole closest to pure discovery; the second (or "low" discoverers), although still working in a framework of discovery, attempt to solve their problems in a fashion more characteristic of presented problem solving.

	Problem Formulation		Method of Solution		Solution	
	Other	Person	Other	Person	Other	Person
"High" discoverers	-	-	-	-	-	-
"Low" discoverers	-	-	-	+	+	+

Fig. 3.01.--Problem Solving Strategies of "High" and "Low" Discoverers

While "discovery" seems to be a useful concept for the description and understanding of the process in an experimental situation, it is questionable whether it might add much to understanding the work of recognized genius. The variables influencing the creation of a masterpiece--although never satisfactorily accounted for--must be so numerous that a uni-dimensional construct such as the one used here pales almost into insignificance. However, an attitude for discovery does seem to characterize the renowned artists through history. It is not the painter with the most refined skills, nor the one whose conceptions were the most grandiose or complex, whom we admire today. Instead, we prize the men who sometimes simply, even awkwardly, explored new ways of interpreting reality, of representing the world and their own reactions to it.

It would have been foolhardy to expect "discovery" on the level of authentic artistic innovation to take place in the experiment itself. Therefore much more modest indicators of discovery had to be used. It was assumed that the process of discovery would manifest itself in some behaviorel signs, and in a conscious concern with discovery on the subjects' part. The results presented in this chapter show that in effect discovery-oriented behavior is manifested by individuals involved in a creative task. Furthermore, such behavior can be rated reliably on a continuum of discovery. And last, discovery-oriented behaviors at various stages of the process were seen to correlate significantly with each other and with the amount of concern with discovery shown in the interview responses.

Therefore the theory and method employed in this work constitute a promising tool for the study of creative processes in the arts. But they must be considered only as a promising tool. Variants of the method can without much difficulty be applied to the study of processes in other areas where creativity is at issue. While this result is in itself valuable, it has the additional merit of suggesting some further questions that are germane to the study of creativity. In the first place, do the indicators of discovery-orientation developed in this study relate to the quality of the product? Do they relate to other known characteristics of the subjects? And finally, what are the implications of the behaviors observed for a cognitive theory of creativity? The next chapters will be devoted to answering these questions.

CHAPTER IV

RESULTS II: ANALYSIS OF THE RELATIONSHIPS BETWEEN PROCESS AND PRODUCT IN DISCOVERED PROBLEM SOLVING

Evaluation of the Product

The results reported in the previous chapter indicate that in the present experimental situation artists do engage in more or less complex discovery-oriented behaviors when working on a creative product. But is discovery-oriented behavior related to the quality of the product? So far several a priori reasons had been advanced suggesting that in order for a meaningful problem to be formulated and solved, the problem-solver must engage in a cognitive process which is qualitatively different from the processes required for the solution of known problems. The ten behavioral variables selected in this study are believed to be some of the relevant indicators (reflections) of the process of discovery.

If these a priori hypotheses are correct, it should be empirically demonstrable that the products of Ss who had engaged in discovery are in some sense different in quality from the products of Ss for whom discovery did not seem to be an issue. In the present case the products were drawings: one criterion of "difference in quality" for a drawing is its aesthetic value. Therefore we would expect that the drawings of the highest aesthetic value were produced by those Ss who had shown most concern for discovery in their behavior during the experiment and in the subsequent interview. In order to evaluate the aesthetic quality of the products five well-known Chicago artists were asked to rate the drawings. The criteria for the ratings were to be completely independent of the criteria used to establish the discovery process variables.

Qualification of the raters

The artist-raters possessed the following qualifications for their task: Artist "A" has had two group shows in the city during the current year, is now teaching art in college. Artist "B" has had one group show and one personal show during the current year, teaches art in college. Artist "C" has had several shows during the past twenty years, has been on the selection committees of many exhibitions; he teaches art in high school. Artist "D" has had two personal shows during the current year, his work is in the collections of Museun and Modern Art in New York and of the Art Institute of Chicago; he teaches art in college. Artist "E" has had several shows in the past, one of his works is in the Library of Congress; he has had experience in art therapy with disturbed children. All five raters consider themselves primarily free-lance artists and have exhibited their work in professional shows. Each has also had teaching experience in art.

Dimensions of evaluation

The artists were asked to rate the drawings on three separate dimensions: (1) Originality (Inventiveness, Imagination)--regardless of craftsmanship ; (2) Craftsmanship (Technical control)--regardless of originality ; (3) Over-all Aesthetic Value (that is, how would the drawings be rated if they were to be awarded prizes in a show?).

The three dimensions were not further defined for the raters. It could have been possible to define very strictly each dimension; this would have assured a high reliability among the raters. However, what would have been gained in reliability might have been lost in validity, since if one defines narrowly such a complex concept as "Originality," the resulting variable would not do justice to the richness of its meaning. By letting each artist interpret the dimension of rating for himself, it was hoped that all the several related shadings of the concept would be represented by the averaged scores of all the raters. Essentially the same reasons prompted Sprecher (1959) not to define for his raters the criterion of creativity in a study of creative engineers.

Format of the rating scale

If the individual preferences of the artist-raters were respected in the definition of the dimensions of rating, it was thought best to impose a structured scale on their judgments. For this purpose a rating-scale which would artificially normalize the scores given by each artist was adopted. With 31 *S*s, the frequency that most closely approaches the normal distribution is the following:

	Score	Number of *S*s to be given this score
high	9	1
	8	2
	7	4
	6	5
average	5	7
	4	5
	3	4
	2	2
low	1	1
		31

The artist-raters were asked to select one drawing to be scored 9 (the highest on any given dimension), one to be scored 1 (the lowest), two drawings to be scored 8 (the two next highest ones), and so on. The structuring of the judgment at first made the judges uncomfortable. Some felt that 9-10 drawings were excellent, the rest very bad; others felt that one or two were outstanding, the others average. But by careful selection they succeeded in discriminating their choices according to the normalized scale. Artist C, who had the most experience in judging art works finished rating the 31 drawings on the three separate dimensions in 45 minutes; artist E took over six hours for his rating. The remaining three artists worked between two and four hours on the task.

Reliability among raters

Table 4.01 reports the correlations between the five artists' ratings on the three dimensions of rating. The correlations are all positive, but several are not significantly different from zero. Raters A and D agree on all three dimensions of rating to a significant degree, and so do C and E. Rater A correlates with the other four raters in six cases out of 12, B in two cases out of 12, C in seven cases out of 12, D in 9 out of 12, and E in six out of 12. It is notable that raters C and D, who showed the highest agreement with the other raters are the two oldest, and the ones with the longest and perhaps most significant artistic experience. In contrast, rater B, who showed almost no agreement with the others, appears to be the youngest of the five artists. He is also the one who rated the drawings according to the most personal criterion: his definition of both Over-all Value and Originality hinged on "Honesty"

TABLE 4.01

CORRELATIONS BETWEEN RATINGS GIVEN BY FIVE ARTISTS TO 31 DRAWINGS

Raters	Dimensions of Rating																	
	Over-all Aesthetic Value						Originality						Craftsmanship					
	A	B	C	D	E	Total 5 Raters	A	B	C	D	E	Total 5 Raters	A	B	C	D	E	Total 5 Raters
A	-	.08	.31	.43	.29	.80	-	.19	.40	.33	.24	.55	-	.21	.09	.33	.34	.62
B		-	.03	.45	.09	.54		-	.11	.29	.13	.50		-	.20	.38	.09	.55
C			-	.34	.59	.71			-	.45	.79	.74			-	.03	.36	.55
D				-	.40	.93				-	.41	.74				-	.27	.77
E					-	.79					-	.68					-	.60

TABLE 4.02

CORRELATION BETWEEN TOTAL RATINGS GIVEN BY FIVE ARTISTS TO 31 DRAWINGS

	Dimensions of Rating	
	Originality (Total of 5 Raters)	Craftsmanship (Total of 5 Raters)
Over-all Aesthetic Value (Total of 5 raters)	.90	.82
Originality (Total of 5 raters)	-	.76

Significance level of correlation coefficients:
.31 to .35 p. = .05. .36 to .41 p. = .025. .42 to .45 p. = .01.
Over .46 p. = less than .005.

or naiveness.

It is well to repeat that if reliability was not higher, this is to a great extent due to the fact that the definition of the concepts to be rated was left vague on purpose. On the other hand, the total scores on the three ratings should represent various shades of the concepts rated. In this context, it should be pointed out that the "total" rating score correlates quite highly with each of the five artists' ratings; therefore it is a representative measure of each artist's definition of the three dimensions.[1]

Table 4.02 shows the correlations between the total ratings on the three dimensions of evaluation. It appears that the criteria of "Over-all Aesthetic Value" and "Originality," "Over-all Aesthetic Value" and "Craftsmanship" overlap to a very great extent. In other words a powerful over-all or "halo" effect intervened in the ratings: a drawing judged to be high on one of these dimensions tended to be rated high on the other. Only "Originality" and "Craftsmanship" appear to be relatively discrete dimensions. But to anticipate some of the findings reported later in the chapter, the homogeneity of the three dimensions of rating does not preclude some very interesting differential effects. For instance, although the ratings on "Originality" and "Craftsmanship" are quite highly related for the five artists, they relate in quite different ways to the discovered process variables observed in the experiment.

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[1] Given the low correlations between rater B and the others, a "Total" rating score including only artists A, C, D and E was also used to compute Table 4.03. The results were very similar, so the total score based on all five artists has been retained throughout.

Relationship between Product Ratings and the Discovery Variables: the Correlation Matrix

If the production of a work of art does in fact require the discovery and solution of a previously unknown problem, then it should be expected that--training in art being equal--people who engage in discovery-oriented behavior should produce a "better" drawing than people who forego discovery. In the present study, some drawings can be "better" than others on three dimensions: Over-all Aesthetic Value, Originality, and Craftsmanship. Do the indicators of the process of discovery relate to any of these three dimensions? On *a priori* grounds, it would be expected that Originality of the drawings (as rated by the five artists) would correlate highest with the total discovery process score. However one defines "originality," the concept must include a novel restructuring of elements: a process which requires involvement in discovery-oriented behavior. It was also thought that the over-all value of the drawings would correlate with the discovery process score. For a product to be creative, originality does not suffice. A novel restructuring of a problem could remain a sterile exercise unless it is in some sense adaptive or functional. Finally, the craftsmanship of the drawings was expected to correlate less with the discovery process score. In theory, technical control on the part of the problem solver need not relate to his ability to discover a new problem.

As Table 4.03 indicates, the hypotheses on which this study is based are confirmed by the artists' independent judgments. The total discovery process score correlates at a very high level of significance with the Originality ratings of the products, it

TABLE 4.03

CORRELATIONS BETWEEN THE RATINGS OF FIVE ARTISTS ON THREE DIMENSIONS OF EVALUATION, AND THE DISCOVERY PROCESS VARIABLES OBSERVED IN THE EXPERIMENT (N=31)

Process Variables	Dimensions of Evaluation		
	Over-all Aesthetic Value (Total 5 Raters)	Originality (Total 5 Raters)	Craftsmanship (Total 5 Raters)
Problem Formulation			
A1 - Manipulation	.48^{b}	.52^{b}	.16
A2 - Unusualness	.35^{e}	.42^{c}	.22
A3 - Exploration	.44^{c}	.58^{a}	.34^{e}
AA - Total	.40^{d}	.54^{b}	.28
Problem Solution			
B1 - Structure time	.09	.08	-.18
B2 - Exploration	.22	.37^{d}	.01
B3 - Changes	.44^{c}	.61^{a}	.37^{d}
BB - Total	.27	.38^{d}	.12
Concern with discovery			
C1 - in general	.20	.24	.12
C2 - in formulation	.40^{d}	.60^{a}	.26
C3 - in solution	.31^{e}	.31^{e}	.24
C4 - changes	.39^{d}	.46^{b}	.38^{d}
CC - Total	.41^{d}	.56^{b}	.31^{e}
Total Discovery Process Score	.48^{b}	.66^{a}	.32^{e}

Significance level of correlation coefficients: a = .0005; b. = .005; c = .01; d = .025;
e = .05.

correlates quite highly with the Over-all Value of the products, and a barely significant correlation is found between the discovery score and the Craftsmanship ratings. Figure 4.01 indicates that in this sample the relationship between the discovery process and the ratings of the products in Originality tends to be linear.

Looking at individual process variables, it appears that variables B1 and C1 do not relate to the value of the products; these were also the two variables that showed the lowest relationships with the other process variables in Table 3.04. That is, "openness of structure" in the solution and "concern with discovery in general" have either been inadequately measured, or they do not play any role in the effectiveness of the product. The variables which are most related to the rating of the products are A3, B3, and C2. Thus amount of exploration while formulating the problem, changes introduced during the process of solution, and concern with discovery while formulating the problem seem to be the most important elements in the process of discovery, in terms of the value of the resulting product.

Relationship between Product Ratings and the Discovery Process: Partial Correlations

As we know from Table 4.02, the three ratings given by the artists are quite highly correlated among themselves. Because of this fact, the positive correlations between the ratings and the discovery process (Table 4.03) are somewhat ambiguous. For instance, are Craftsmanship and the discovery process correlated only because they both share a common relationship with Originality or Over-all Value? That is, if the common variance of Craftsmanship and Origi-

Combined Originality Ratings (5 Artists)	Total Discovery Process Score (ABC)										
	3	4	5	6	7	8	9	10	11	12	13
38											S.05
37											
36											S.01
35						S.30					
34								S.23			
33										S.11	
32					S.20						
31										S.16	
30						S.27					
29											
28									S.02		
27								S.08			
26					S.15						
25				S.25			S.12	S.06		S.17	
24								S.31			
23			S.28	S.24 S.07		S.21					
24		S.04			S.22	S.03		S.26			
21											
20		S.29			S.19 S.18						
....											
18			S.13								
17			S.10								
....											
14						S.14					
....											
11	S.09										

Fig. 4.01.--Scattergram illustrating the relationship between the Total Discovery Process score and the product ratings by five artists on Originality.

TABLE 4.04

ZERO AND FIRST-ORDER PARTIAL CORRELATIONS BETWEEN THE PROCESS SCORES AND THE PRODUCT RATINGS

Correlations between the Total Process score (ABC) and:	Zero-order rho (same as Table 4.03)	Variables Held Constant	(A) First-order Partial Correlation
Over-all Value	.48	Originality	-.35
Over-all Value	.48	Craftsmanship	.40
Originality	.66	Over-all Value	.60
Originality	.66	Craftsmanship	.68
Craftsmanship	.32	Over-all Value	-.17
Craftsmanship	.32	Originality	-.37

nality were to be removed, would Craftsmanship still be correlated with the discovery process?

Table 4.04 presents some of the results obtained when the variance held in common by the three ratings is partialled out. Column A of the table shows that with Originality held constant, the Over-all Value of drawings by "high" discoverers tends to be less than that of "low" discoverers. It must be remembered that in practice it is difficult to separate Originality from Over-all Aesthetic Value--the two dimensions are related .90 in Table 4.02. Yet we see that with either Over-all Value or Craftsmanship held constant, the rated Originality of the drawings is still highly correlated with the discovery process. These results suggest that if one can talk of the three constructs in an abstract sense, as "pure" dimensions of evaluation, then the discovery process is related to products which are characterized primarily by Originality. High discovery is in fact related to low "pure" Craftsmanship. What has been said above is even more clearly illustrated by Table 4.05.

TABLE 4.05

SECOND-ORDER PARTIAL CORRELATIONS BETWEEN THE RATINGS OF THE PRODUCTS AND PERFORMANCE ON "PRESENTED" AND "DISCOVERED" PROBLEMS

	Variables Held Constant:	A Discovered Problem Solving Process (ABC)	B Presented Problem Solving Process (Vigotsky Total)
Over-all Aesthetic Value	Originality and Craftsmanship	-.21	-.04
Originality	Over-all Value and Craftsmanship	.90***	-.30
Craftsmanship	Over-all Value and Originality	-.53**	.47**

***p. = .001. **p. = .01.

There we see the correlations between the process and each dimension of the product, with the other two dimensions held constant at the same time (column A). Thus the correlation between the process and Originality jumps to a near perfect .90 when both Over-all Value and Craftsmanship are held constant; the correlation between the process and Craftsmanship sinks to a low -.53 when the two other dimensions are partialled out. By contrast, if we examine the relationship of a "presented" cognitive process to the value of the products (Column B, Table 4.05), we see that ability at solving a known, given problem is related to "pure" Craftsmanship, and unrelated to either Over-all Value or Originality. The Vigotsky test had been administered to the subjects because of its functional similarity with the "discovered" artistic problem: it differs from the latter in that the Vigotsky has only one correct formulation, method of solution, and solution.

The pattern in Table 4.05 suggests that two usually unrelated cognitive processes affect two different, but related aspects of a work of art. High "discovery" is unrelated to the ability of solving "presented" problems (see Table 5.04, Chapter V), yet the former seems to affect the original qualities of a drawing, the latter its craftsmanlike qualities. Perhaps this complex web of relationships represents an embrionic model of the interaction between imagination and skill: the definite formulation of such interaction ought to be of considerable importance to the study of creativity.

Summary and discussion

On the basis of the data reviewed in this chapter it can now be said with a relatively high degree of confidence that a cognitive process aimed at discovery is not only observable during the production of a creative work, but also that it is concomitant with products of a higher quality. What are the implications of this finding in terms of a cognitive theory of creativity? At this point a tentative view will be advanced: an explanation that goes a long way beyond the facts observed, but which is worthy of mention for its heuristic value.

Let us begin by taking variable A1 as an example. As shown in Table 4.03, the students who manipulated more objects produced drawings which professional artists rated as more original and valuable (but not superior in technique). Equating high rating by artists with successful formulation and solution of the discovered problem, it follows that manipulation of the problematic elements is conducive to successful discovered problem solving. Subjects who selected the first object that appealed to their fancy, without considering alternate possibilities, did not produce successful drawings. Does this imply that artists in general need to manipulate objects in their environment to paint a work of art? Probably not. It should be remembered that the experiment was so structured that the subjects had to select certain objects. Now let us suppose instead that the subjects had been led into a bare room, and asked to make a drawing from memory. In such a hypothetical situation there would have been no objects to manipulate, yet we might assume that the same subjects who solved the problem successfully in the real experiment would have also done so in the hypothetical one. Is then manipulation of objects completely irrelevant to the quality of the drawings? The suggestion to be advanced here is that in the hypothetical experiment--the one where the environment contains no stimuli--the Ss who manipulated objects in the real experiment would tend to "manipulate" more ideas, or emotions (in short, internal stimuli) before they begin drawing. The Ss who had a low score on manipulation may in such a situation focus on the first idea, or emotion, without going through the process of selection in which alternate ideas are considered.

According to this view then the process observed in the present experiment was the externalized counterpart of an analogous process which would have occurred internally, had the instructions not specified that the drawing was to be formulated in terms of the available objects. Thus it is not the specific content of the process of discovery that matters, but its functional characteristics. What the experiment forced out in the open may have been some of the motions that take place in the "black box" of the creative problem-solver's mind. As has been said before, this interpretation is as yet far from substantiated, and the present study cannot advance any proofs for its correctness. But to pursue the argument further, what is the meaning of variable A2 if the above assumptions were to hold true? The observations on which this variable is based refer to the unusualness of the objects selected for drawing. According to the "black box" analogy, the Ss who chose the more unusual objects also focus among their ideas on the more unusual ones. In the quiet of their studios, these artists would begin a painting "inspired" by more personal, less obvious memories or experiences. By contrast the Ss who in the experiment selected objects of wider appeal might, when they plan their next painting, use some tried and less personally felt subject-matter for their work. The same analogy can be drawn concerning variable A3, experimentation with the objects selected. If our extrapolations are correct, the artists who in the experiment tended to feel the objects, who turned them around and moved them, who tried to change them and to find out their possibilities--these artists would tend usually to experiment with ideas and feelings in a similar way. The artists who did not experiment with the objects but based their choices solely on obvious visual qualities, should be the ones who take ideas for granted, who are happy with the accepted definition of things.

It is possible to draw the analogy for all the other variables, but the point ought to be clear already. The implications of the experiment are seen to transcend the limited situation in which objects had to be used for the envisagement of the artistic problem. The use of objects was fruitful because it suggests an analogy--but we emphasize, it is only an analogy as yet--with the mental processes at work when the artist develops ideas for his next creation. In this light, the concrete steps in "discovery" inferred from the manipulation and choice of objects may be extended to describe steps in discovery which could not otherwise be observed. In the concluding chapter we will expand on some of the implications that the process of discovery as observed in this experiment has for creative thinking.

CHAPTER V

RESULTS III: THE DISCOVERERS--AN ANALYSIS OF SOME PERSONAL CONCOMITANTS OF DISCOVERY ORIENTATION

The focus of this study so far has been on the process of discovery and on its products. In this chapter the focus will be shifted to the individuals who by the experimental observations were seen to have the highest total discovery process scores: the "high" discoverers. Are these students different on any conventional psychological measure from their peers who are less discovery oriented?

Cognitive Variables

Since discovered problem solving is a cognitive process, the first question to emerge in connection with individuals who are high discoverers is whether they also score higher on other measures of cognition. Scores on several cognitive instruments were on file for all the students who have taken part in the experiment. In particular, there were results on two generally used intelligence tests, and a composite score based on three Guilford-type divergent tests, widely used to measure creativity.

In order to examine differences between the high and low discoverers, the 11 Ss with the highest total discovery process score (9 and above, Table 3.01) were contrasted with the 14 Ss who had the lowest scores (7 and below, Table 3.01). The mean scores of the two groups on the cognitive tests are reported in Table 5.01. The mean of the high discoverers is not significantly larger on the two intelligence tests, but it is on the combined scores of three divergent thinking tests. Although the difference is barely significant, it is indicative of the creative nature of the discovered problem-solving process: tests of divergent thinking, originally developed by Guilford, have been used as criterion measures of creativity by Barron (1955), Birney (1961), Fleming (1962), Holland (1961), Maltzman (1960), Weisberg (1961), and many others.

TABLE 5.01

MEAN SCORES OF HIGH AND LOW DISCOVERERS ON THREE COGNITIVE INSTRUMENTS

	N	Wonderlic Intelligence		16 P.F. Intelligence		Divergent Thinking Tests[a]	
		Mean	s.d.	Mean	s.d.	Mean	s.d.
High discoverers	11	23.00	5.71	5.55	2.39	44.73	12.43
Low discoverers	14	20.65	5.01	5.50	2.89	36.15	12.83
"t" value of diff. between means		1.15		.04		1.74	
"p" value of "t"		NS		NS		.05	

[a] This is a linear combination of scores on Brick Uses (Flexibility), Unusual Uses, and Ideational Fluency; three tests which in a previous study were found to load equally high on a "Divergent Thinking" factor, and which have very similar ranges, means, and standard deviations (Getzels and Csikszentimihalyi, 1964, p. 182).

In order to understand better the relationship of discovery orientation and divergent thinking, Table 5.02 reports correlations between the three sub-scores of the total process score and the cognitive tests.

The highest correlation appears between divergent thinking

TABLE 5.02

CORRELATIONS BETWEEN DISCOVERY PROCESS VARIABLES AND COGNITIVE TEST PERFORMANCE
(N=31)

Process Variables	Wonderlic Intelligence	16 P.F. Intelligence	Divergent Thinking Tests[a]
Problem Formulation (AA)	.25	.17	.51**
Problem Solution (BB)	.06	-.03	.19
Concern with Discovery (CC)	.11	_.01	.07
Total Discovery Score (ABC)	.18	.05	.32*

*p. = .05 **p. = .005

[a] See note to Table 5.01.

and the problem formulation stage of the discovery process. This is a very meaningful relationship, since it is at the formulation stage that the problem solver needs to be most open to alternative possibilities, which is the aptitude measured by the divergent tests. The table shows that Ss who were observed engaging in the greatest variety of discovery-oriented behavior during the formulation of the problem, had achieved the highest scores on divergent thinking tests taken one year prior to the experiment. This finding not only tends to support the validity of the process variables, but also to indicate the stability over time of the underlying process measured.

The Presented Problem-Solving Situation

One question that promised to be interesting was whether performance on the discovered task bears any similarity to performance on a presented task. As a measure of presented problem solving the Vigotsky concept formation test was chosen. In the proposal for this study it was suggested that individuals who are oriented towards discovery might not perform as well on a problem where there is only one known right answer, such as the Vigotsky. Table 5.03 compares the means and standard deviations of our sample with the means of the normative groups reported by Hanfmann and Kasanin (1942). The total performance score of our sample of art students falls almost exactly half way between the means of normal Ss with superior education and normal subjects with average education. Assuming the same standard deviations for the norms and our sample, the means of the art student group on both performance and time would be different from those of both normative groups at better than the 1 per cent level of probability. Given the educational level of the art students, their performance should in fact fall between that of the two normative groups. However, since the normative group with "superior education" had only four years of college, and two-thirds of the "average education" group had only a grammar school education, the art students should have scored somewhat higher.

But the crucial question is whether discovered problem solving is related to a higher performance on the "presented" Vigotsky test. As Table 5.04 indicates, the correlations between the discovered process variables and the Vigotsky scores are insignificant, although generally negative. The only significant coefficients appear between some of the discovered process variables and the Vigotsky time-help score, suggesting that the more discovery-

TABLE 5.03

PERFORMANCE ON THE VIGOTSKY TEST: ART STUDENTS VS. NORMS

	N	Total Performance Score		Time-help Score	
		Mean	s.d.	Mean	s.d.
Art students	31	28.4	5.53	38	16.7
Normal Ss with superior education*	50	31.0	-	31	-
Normal Ss with average education*	45	24.8	-	60	-

*Hanfmann and Kasanin (1942, p. 58).

TABLE 5.04

CORRELATIONS BETWEEN VARIABLES MEASURING DISCOVERED AND PRESENTED PROBLEM-SOLVING PERFORMANCE

Process Variables		Vigotsky Scores				
		Interpret of task 1	Attempts at Solution 2	Finding Solution 3	Total (1,2,3) 4	Time-help 5
Problem Formulation	(AA)	.09	-.06	-.05	.02	.12
Problem Solution	(BB)	-.28	-.03	-.14	-.14	.30*
Concern with Discovery	(CC)	-.29	-.12	-.28	-.22	.32*
Total discovery process score	(ABC)	-.21	-.10	-.22	-.16	.33*

*p. = .05

oriented Ss took a longer time to solve the presented task.

When discovery sub-scores were examined, the highest negative relationship appeared between discovery process variable C1 (Concern with discovery in general) and the Vigotsky "finding solution" score.

The rho of -.41 (p. = .01) implies that when a S is highly concerned with discovering a new problem, he might have difficulty in recognizing the solution to a known problem. What is an accepted, orthodox solution may not appear as a real solution to the questioning artist--which reminds us of a remark attributed to Einstein, "I had to find something new because I could not understand the old." (For the relationship of the Vigotsky with the quality of the products, see Table 4.05.)

Scholastic Performance and Artistic Achievement

Are the discoverers better students in art school? Do their teachers see them as being more creative? In theory the answers should be "yes" to both questions. However, as several previous studies have shown, teachers' ratings of creativity in school are likely to be contaminated by many irrelevant factors, such as academic achievement (Holland, 1959). In the school under study, both teachers' ratings and art grades related much more to the students' personality characteristics than to cognitive aptitudes (Getzels and Csikszentmihalyi, 1964). Therefore the lack of relationships shown in Table 5.05, although remaining something of a mystery, was not a surprise. The only hint of an explanation is given by the correlation between discovery-oriented behavior in the stage of problem solution and the teachers' ratings of creativity. Perhaps teachers at the school consider discovery in the methods of solution--that is, originality in the execution of a drawing--more important than the formulation of a new problem. If this is the case, it would not be surprising, since originality in the methods of solution is easier

TABLE 5.05

CORRELATIONS BETWEEN DISCOVERY PROCESS VARIABLES AND ARTISTIC PERFORMANCE IN SCHOOL
(N=31)

Process Variables		Average Art Grades	Teachers' Ratings of Creativity
Problem Formulation	(AA)	.02	.07
Problem Solution	(BB)	-.01	.32*
Concern with discovery	(CC)	-.10	.06
Total discovery process	(ABC)	-.05	.18

*p = .05

to assess than originality in problem formulation. In general, the conclusion to be drawn is that discovery-orientation bears no relationship with rewards obtained in school.

The two groups differ remarkably when one considers the number of extra-scholastic shows and exhibits in which the Ss have participated. On the average, each high discoverer had entered his works in 1.91 shows outside the school, the figure for the low discoverers being .64, or one-third smaller. Table 5.06 shows the chi-square distribution.

TABLE 5.06

NUMBER OF EXTRA-SCHOLASTIC SHOWS AND EXHIBITS PARTICIPATED IN BY HIGH AND LOW DISCOVERERS

	N	Had one or more Shows or Exhibits	Had No Show or Exhibit
High discoverers	11	10	1
Low discoverers	14	5	9

Fisher's exacta: p. = .006

However, the number of prizes and scholarships received in art did not differentiate the two groups. The high discoverers received an average of 1.45 scholarships during their career in school, the lows an average of 1.50. Thus while the discoverers apparently try harder and are more ready to expose themselves professionally, they are not rewarded proportionately for their efforts in school: a suggestion which further confirms the impression derived from the lack of relationships in grades and teachers' ratings.

It is also worthy of note that the high discoverers became interested in art at an earlier age than the low Ss. To the questionnaire item: "When did you begin to do art work in excess of your school assignments as part of your regular activities?" the high Ss' mean answer was: "between grades 4 and 5 in grammar school"; that of the low Ss': "between grades 7 and 8 in grammar school." Table 5.07 shows the significance of this trend.

TABLE 5.07

AGE AT WHICH SUBJECTS BEGAN TO DO ART-WORK IN EXCESS OF SCHOOL REQUIREMENTS

	N	Before Grade 7	After Grade 7
High discoverers	11	9	2
Low discoverers	14	4	10

Fisher's exacta: p. = .01

Torrance (1962), among others, has observed that around age 10 (grades 4 and 5) the creativity of school children suffers a severe dip. It is perhaps meaningful in this context that it was at about the same age that our high discoverers began to work seriously in art. It may be interesting to speculate whether by finding a means to continue expressing the imaginativeness and curiosity of their earlier years through art, the high discoverers were able to preserve these characteristics in later years.

Personality Variables

The discovery process variables were also entered into a matrix containing the available personality test data, to determine whether some of the personality scales would show a significant relationship with discovery orientation. The results showed that none of 16 factors of Cattell's 16 PF Inventory, nor any of the values of the Allport-Vernon-Lindzey value scale discriminated between the discoverers and the presented problem solvers.

This lack of relationships might be due to one of two causes: either orientation toward discovery is in fact uncorrelated with the personality measures at hand, or the lack of relationships is a result of the generally extreme scores that the group of students as a whole achieved on these measures. As was indicated in a previous study (Getzels and Csikszentmihalyi, 1964), our sample had a mean Aesthetic value of more than two standard deviations above the college norms, and scored at the 83rd percentile on Imaginativeness (16 PF factor M), 77th percentile on Sensitivity (factor I), 83rd percentile on Self-Sufficiency (factor Q2), etc. Thus within such a limited range of scores, the value and personality tests might not be able to differentiate between the high and low discoverers.

A more promising pattern emerged from the TAT responses. The

TAT had been administered in a group situation, and four slides were presented according to the usual procedures (Atkinson, 1958). The responses were scored for "novelty of productions" (Maddi et al., 1962). As shown in Table 5.08, the high discoverers tended to write stories with a higher novelty content than the low discoverers.

TABLE 5.08

TAT "NOVELTY OF PRODUCTION" SCORES OF HIGH AND LOW DISCOVERERS

	N	Novelty Score 2 and Above	Novelty Score 1 and 0
High discoverers	10*	8	2
Low discoverers	13*	6	7

Fisher's exacta: p. = .09

*One S in each group failed to complete the TAT.

A further way of analyzing the TAT protocols was to look for discovery-related content. One of the slides represented a man working at a desk, with a dog lying at his feet and a large bird perched in a corner; the scene suggested the 1860's (the man is usually identified by respondents as either Audubon or Poe). It was thought that this slide would lend itself to projections of discovery-related imagery. Consequently a scoring system for discovery-imagery was developed, and applied to the 23 protocols. Four Ss in the high group wrote stories involving discovery, none of the low group did. But a more striking trend emerged from the analysis: the stories of the high Ss were much more humorous than those of the low Ss. When both discovery-related imagery and humor were taken into consideration, the difference between the two groups was quite remarkable (Table 5.09). An independent rater also scored the protocols for discovery and humor, with 83 per cent over-all agreement.

TABLE 5.09

TAT "DISCOVERY" AND "HUMOR" CONTENT OF STORIES WRITTEN IN RESPONSE TO SLIDE #3. SCORED BY TWO RATERS

	N	Rater "A"		Rater "B"	
		Discovery or Humor Present	Discovery or Humor Absent	Discovery or Humor Present	Discovery or Humor Absent
High discoverers	10	7	3	8	2
Los discoverers	13	1	12	3	10
Fisher's exacta:		p. = .003		p. = .009	

Humor in the projective test responses of creative children has also been observed by Getzels and Jackson (1962), and it is in general conceded that humor and creativeness might be somehow related. The concept of "discovery" as used in the present study can perhaps help clarify the nature of this relationship. We suggest that to write a humorous story to a TAT stimulus is equivalent to a re-formulation of a presented problem. Instead of thinking up a story that would follow from the given stimulus, the high discoverer tries to change the nature of the stimulus (or problem) to see what else can be done with it besides the obvious solution. There are only a limited number of stories that can be written about a man working at his desk, so some of the Ss change him into a "woman playing the piano" or a "devoted artist in Greenwich Village suffering without an Italian sweater," or "M. Margritte, not knowing of the impending disaster (he is in reality Lois Lane). . . ." Obviously such whimsical treatment of responses does not imply a real discovery. But it is an attempt towards one, limited by the four minute deadline in which the solution has to be given. Or more precisely, the humorous distortions of the discoverers imply a refusal to deal with the stimulus in a "presented" fashion. It goes against their grain to write a more or less foreseeable answer to the stimulus; the solution would be too easy, too pat. Lacking the time to write a really "creative" story that would involve discovering meaningful new possibilities in the problem, they re-structure it arbitrarily and somewhat autistically.

Other frequent contents found in the TAT stories were "financial concern" and "alienation." Several Ss saw the man in slide #3 as worrying about the money he might get from his work, or about being isolated from society. Combining these two content categories, it was found that two high and six low Ss manifested either or both financial concern and concern for acceptance. Percentage of agreement between two raters on these two dimensions was 93 per cent, the chi-square table based on both raters' scoring was identical (Table 5.10). What is even more significant, both the high Ss who manifested such concerns did so in a humorous vein, while all six low Ss were serious about their preoccupations.

Although the trend in Table 5.10 is not significant, it suggests that artists who are concerned with discovery are not seriously worried about financial results or social acceptance.

Family Background

Several writers have found trends indicating that the family structure and interaction of creative children has distinguishing

TABLE 5.10

"FINANCIAL CONCERN" AND "ALIENATION" CONTENT OF STORIES WRITTEN IN RESPONSE TO TAT SLIDE #3. SCORED BY TWO RATERS

	N	Financial Concern or Alienation Present	Financial Concern or Alienation Absent
High discoverers	10	2	8
Low discoverers	13	6	7

Fisher's exacta: p. = .15

characteristics (Getzels and Jackson, 1961, 1962; Torrance, 1962). Are there any indications of a pattern that might distinguish the high from the low discoverers along such lines? It had been observed by various researchers that sibling position seems to be a recurring concomitant of creativity; Torrance states: "The creative child is often an older sibling" (1962, p. 77), and Roe (1951) found that eminent scientists were more often first born. These observations apply to our discoverers: 9 out of the 11 of the high discoverers are oldest siblings, while only 4 out of the 14 low discoverers are (Table 5.11).

TABLE 5.11

SIBLING POSITION OF HIGH AND LOW DISCOVERERS

	N	Oldest Sibling	Other: Only Son, Middle or Youngest Sibling
High discoverers	11	9	2
Low discoverers	14	4	10

Fisher's exacta: p. = .01

The parents of both high and low discoverers went through school for almost exactly the same number of years. The fathers of high Ss tend to work in jobs of higher status: three fathers in this group are professionals, while none of the low Ss' fathers are. The widest difference appears in the level of the parents' income: as Table 5.12 shows, the parents of the high discoverers are significantly more affluent.

TABLE 5.12

INCOME OF PARENTS OF HIGH AND LOW DISCOVERERS

	N	Less Than $7,500 a Year	More Than $7,500 a Year
High discoverers	11	1	10
Low discoverers	14	9	5

Fisher's exacta: p. = .006

It is of course hazardous to say anything certain regarding the early life of our subjects from these meager autobiographical data. Nonetheless one may wonder whether the Ss who display low interest in discovery may not have had relatively more deprived childhood experiences. One may also wonder whether the fathers of the high Ss had a higher level of achievement drive; with the same amount of education, they reached better occupations and higher incomes than the fathers of low discoverers. In fact, four fathers of Ss in the low group had occupations with a lower status than their education warranted: two who had finished high school and one who went to college were skilled workers, and one who had finished high school was an unskilled worker. By contrast the five fathers of high Ss' who had finished high school all had clerical or business jobs.

The family background information discussed above was gathered through a short questionnaire form, and so it barely touches the issue of a possible relationship between discovery orientation and family environment. The fact that any significant trends were found under such conditions suggests that this line of enquiry could be fruitfully pursued.

Summary and Discussion

The data surveyed in this chapter has contributed to the definition of the discovery process by focussing on the people who more frequently engage in it. It has been shown that the "discoverers" manifest several characteristics previously attributed to creative people. The higher divergent test scores of the discoverers indicate a kinship between the two processes; in particular, the ability to think along unconventional lines was found to play a role in the process of questioning, defining and formulating the discovered problem. However, as the level of the correlations suggests, the total discovery process involves more than divergent thinking. Conventional intelligence, presumably above a certain minimum cut-off point, does not seem to play a decisive additional role in the process of discovery for artists. This statement is corroborated by the data of the Vigotsky: here ability to solve a conventional presented problem showed a slight negative relationship to discovery orientation.

The high discoverers were found not to differ from the low in terms of art grades, scholarships, or teachers' ratings of creativity. They did, however, exhibit their work much more often in public shows. The discoverers reported an earlier involvement with the production of art. This trend suggests that discovery orientation might be related to the ability to maintain an imaginative cognitive style at a developmental stage in which most children tend to abandon drastically imaginative ways of thinking.

Stories written by the discoverers in response to a projective stimulus abound in humor and discovery content, while the low discoverers write stories in which financial and social preoccupations are important elements. Extrapolating perhaps somewhat too daringly from the limited data, it was indicated how humor as a style of test response can be interpreted within the discovered problem-solving schema. In effect, humor seems to be a short-circuiting of the discovery process which the respondent adopts in order to avoid solving the problem in a "presented" way, when he has no time, skill, or inclination to re-formulate the problem meaningfully.

The information on the Ss' family background suggests that the discoverers belong to stable or upward mobile families, have fathers with relatively high achievement and comfortable income. The predominant majority of the discoverers were found to be oldest sons, a further link between them and creative individuals studied previously.

The collateral information assembled here tends to support the claim that discovered problem solving is a relevant factor in creativity. Many typical characteristics of creative people are found in the group of high discoverers--one more suggestion that the ~~that~~ discovered problem-solving process they engage in may be distinctive of creative endeavor.

With this chapter, we have ended the analysis of the process of discovery, and its relationship to the artistic product and to the artist himself. The next two chapters will deal with two supplementary questions which emerged in the course of our investigation. The first question was: Are there any identifiable perceptual characteristics that might differentiate artists from non-artists? What, for example, would be the nature of the artists' responses as compared with non-artists' responses to a standard perceptual stimulus like the Rorschach? The second question involved the recurring problem of the criterion. In the investigation proper we resorted to the judgment of a group of independent artists to establish the criterion of relative value of the artistic products. What is the relationship between the ratings made by such group and the ratings made by an art teacher group, and by non-artist groups? Are there any systematic regularities or irregularities in the ratings of art products by the different groups?

CHAPTER VI

RESULTS IV: EXPLORATIONS OF THE PERCEPTUAL PROCESSES OF ARTISTS

The present chapter deals with the question of possible perceptual differences between artists and non-artists. The perceptual stimulus used was the Rorschach.

The rationale for selecting this stimulus was quite simple. We needed for this initial exploration a standardized method for observing "perceptual styles" - one for which normative data were already available. This it seemed to us was offered by the Rorschach, which requires a perceptual response and for which some norms are at hand. The usual function of the instrument as a clinical device and the controversies regarding its use in this respect were not relevant to our purpose. It was not our concern to make any differential diagnosis as to the personality structure or emotional stability of our subjects. We were interested only in exploring what they "saw" as against what others "saw" when confronted with the Rorschach patterns. If we refer to the diagnostic "meaning" of the various responses, it is only to give the "standard" definition of the individual determinants.

We wish to emphasize at the outset that the observations to be discussed are highly tentative, and to be taken only as possible directions for further study. The main reason for this cautionary attitude is that there was no way to assess the consistency between our scoring of the Rorschach and that used in developing the normative data against which the responses of the artists were compared. Although the assistant who administered the test and scored the protocols in our investigation studied with Professor S. Beck, on whose work the normative data are based, it is still highly possible that some of the extreme differences noted in Table 6.01 may be due at least partly to differences in scoring.

With this serious qualification in mind, we will present data relative to two main questions:

1. Does the sample of artists differ from the "norms" on any of the perceptual categories?
2. Do any of the categories relate to the discovery process, or to the quality of the products?

Before answering the above questions, we present a short section on the procedures used in administering and scoring the test.

Procedures

Twenty-eight of the 31 Ss took the Rorschach test; of the three who did not, one had left the city and two were unavailable during the testing period. Participation was voluntary. Most Ss were tested in a room made available at the School of the Art Institute, though a few were tested in their homes. Sessions ran from as short as one hour to as long as five hours, with a median of 2.5 hours.

The test was administered according to the standard procedures described in Beck (1961). In order to alleviate the expected occasional concern about the esoteric nature of the test, in addition to the standard instructions, the Ss were given the following explanation, consistent with the major aims of the study as a whole.

We are interested in the kinds of thinking--perceiving proc-

> esses artists use in handling visual materials. The drawing situation gives the artist the opportunity to do just as he likes with the materials available. We chose these inkblots because they also provide a free visual situation where the individual is free to handle the material as he chooses.

The scoring procedure followed as Beck's (1961), with some subdivisions and additions taken from Klopfer (1962) and Binder (1933).

Comparison of the Sample with Available Norms

To compare two groups on single Rorschach determinants is an exercise of limited usefulness. First of all, the already mentioned reliability problem should always be kept in mind. Second, on theoretical grounds it is not the difference between any two scores that is really meaningful in the Rorschach but the whole pattern of high and low scores down the list of determinants. Finally, many of the categories are presumed to have a curvilinear relationship with the construct they supposedly measure; for instance, a high number of responses to the test should relate to creative productivity, but it can also indicate a compulsive need for quantity (Klopfer, 1962). There are few, if any, guidelines for establishing clearly at what point "much" becomes "too much."

With these unavoidable limitations in mind, we may proceed to examine the data in Table 6.01 for the leads they may offer to further work. In this table we compare the pattern of responses of the artists in our sample with that of a group of 157 individuals "representative of the middle range of urban (Chicago) Americans," exclusive of the upper 5 per cent in intelligence (Beck et al., 1950). The first row of the table indicates that the artists in general gave more responses. Since reliability should not be too serious a question for this variable, this result is worth noting. (The difference in number of responses has a "t" value of 2.31, which

TABLE 6.01

A COMPARISON OF ART STUDENTS WITH NORMS ON PERCENTAGE RESPONSES GIVEN IN VARIOUS STANDARD RORSCHACH CATEGORIES. NORMATIVE DATA FROM BECK ET AL., 1950, P. 296

Scoring Categories	Norms (N=157)		Art Students (N=28)	
	Mean	s.d.	Mean	s.d.
Number of Responses (R)	32.65	17.68	43.21	23.14
Percentage Wholes (W)	19.81	11.10	40.00	19.23
Percentage Details (D)	71.94	12.95	53.32	16.22
Percentage Small Detail (dd)	8.23	7.95	6.61	9.27
Human Movement (M%)	10.7	9.9	15.4	8.2
Space (S%)	5.9	6.5	23.6	8.0
Light (Y%)	6.0	6.8	33.9	9.2
Color (C sum %)	9.5	8.4	18.6	8.9
Color (C pure %)	1.5	2.5	2.1	2.3
Color/Form (CF%)	4.4	5.4	6.5	4.6
Form/Color (FC%)	4.2	3.7	10.6	5.6
Vista (V%)	5.6	6.3	2.7	2.5
Good Form (F+%)	79.3	10.2	61.4	14.9
Form (F%)	70.2	13.7	35.4	12.5
Human Form (H%)	12.3	11.1	25.8	11.9
Animal Form (A%)	46.7	13.2	39.2	12.4

with 33 degrees of freedom[1] is significant at the .025 level of probability.) Inasmuch as a higher number of responses is an indication of intelligence and creative productivity, it seems that our sample is significantly above average on this variable.

The remaining entries in Table 6.01 show the percentage of responses that were scored in each category. Since each response could be scored in more than one category, the percentages do not add up to one hundred. To consider only the most common determinants, from M per cent down to V per cent, the over-all pattern shows that a substantially higher percentage of the artists' responses were given in these categories. While this might be due to the examiner's bias, our impression is that the artists did in fact have unusually complex percepts which could be scored in several categories at once.

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[1] See W. J. Dixon and F. J. Massey, Introduction to Statistical Analysis. New York: McGraw-Hill, 1957, pp. 123-24.

Among the more salient differences is the one involving the relative number of "whole" percepts as opposed to "detail" percepts. The artists gave twice as many whole responses as a percentage of the total number of responses when compared with the available norms. Since the scoring of W and D are relatively objective, it can be assumed that at least part of the difference is reliable. A high W score is taken to be a reflection of conceptual activity (Beck, 1961). of concern with the abstract and theoretical (Klopfer, 1962); the low D per cent shows a relative lack of practical, every-day common sense intelligence (Klopfer, 1962).

A higher M per cent is a reflection of "feeling turned inward," of "the converting of emotion," of "fantasy"; a process that in healthy individuals can help achieve the new (Beck, 1961). According to Klopfer, it suggests imagination and empathy. It should be noticed, however, that of the eight determinants (M.....V), M is the most frequent in the normative sample; among the artists it is only fourth in order of frequency.

Direct responses to white space (S) were observed about four times as often among the artists. Given the relatively objective nature of this score, it is unlikely that all, or even most, of the difference could be accounted for in terms of scoring bias. A high S implies opposition, tenacity as stubbornness. A low S would be a sign of passivity or suggestibility (Beck, 1961).

The difference in the percentage of responses involving the perception of "light" is again extreme, and despite the possibility of discrepancies in scoring, it is probably at least in part a reliable difference. Klopfer describes this response as an unsuccessful attempt to achieve a three-dimensional percept. In this sense it might be in line with the perceptual requirement of artists to try and project the flat stimulus in three dimensions, even if this is often not possible. Regarding its personalistic implications, Klopfer claims Y to connote anxiety concerning affective needs, and Beck sees it as a sign of positive but painful withdrawal. Again, both these conditions seem sensible when applied to artists.

Next, we notice a difference in favor of the artists concerning the percentage of responses significantly determined by color. In general, color indicates responsiveness to the interpersonal environment (Klopfer, 1962). The largest difference seems to originate in the relative percentage of FC, or percepts where color is secondary to form. Klopfer sees these responses as indicating well handled emotional responsiveness, a dependable sign of good adjustment. This finding, if reliable, should be a significant contribution to the controversial question about the role that emotion and its control play in the artist's personality.

The difference in "vista" responses (V) is based on negligible numbers, but its direction complements that of the pattern shown by S. The artists were low on V, which implies lack of submissiveness and passivity (Klopfer, 1962)--this fits with the artists' higher score on S, associated with the same meaning.

A large difference is also found between our Ss and the norms in the number of responses in which form enters to a significant degree in the definition of the percept. At first the artists' low F per cent might seem puzzling since this response reflects, according to Klopfer, intellectual control. But, as Table 6.02 suggests, in this sample the tendency to perceive in terms of form is negatively related to intelligence, as measured by Cattell's 16 P.F. factor B. Pure color responses--considered to reflect uncontrolled emotionality --are also negatively related to intelligence. But form determined color responses (FC) are related to intelligence at the .01 level of probability. The implication is that pure form as well as pure color determination of percepts is in this sample associated with relatively lower intelligence. A higher level of intellectual functioning is achieved by artists whose percepts are determined by well-controlled emotion.

TABLE 6.02

CORRELATION OF INTELLIGENCE SCORES WITH PERCENTAGE OF RORSCHACH RESPONSES DETERMINED BY FORM AND COLOR INDEPENDENTLY, AND IN COMBINATION (N=28)

Percentage of Rorschach Responses	16 PF Factor B (Intelligence)
Form (F%)	-.43*
Form-Color (FC%)	.42*
Color (pure)	-.15

*p. = .01

Finally, the artists gave twice the normative number of percepts involving the whole human form (H). As the reliability in scoring this determinant should be fairly high, we may assume that the artist sample tended to have "a more mature intelligence, "which is Beck's interpretation of this response. Conversely, the artists reported relatively fewer animal percepts. High A is interpreted by Beck as lack of spontaneity, by Klopfer as stereotypy in thinking.

Again, keeping in mind all the qualifications advanced in the opening paragraphs of this section, the comparison of scores in Table 6.01 yields a pattern which is consistent with what is known about artists. Their style is characterized by complex percepts tending to be organized into wholes. Human content and human movement are frequently seen. Form is not the most important determinant of the percept. White space is often responded to, and light effects are almost as frequent as form responses--possibly an indication of the constant shift between two and three dimensional perception which is basic to the artist's task. Color, especially in conjunction with and subordinated to form, is also a frequent percept. Interpreted in terms of their personalistic correlates, the perceptual differences characterize our Ss as being concerned with abstract and theoretical matters (high W), as having high fantasy and imagination (M) and mature (H) but not very controlled (F) intelligence. The artists are also seen as stubborn and low in suggestibility (S), withdrawn and anxious about affective needs (Y), but handling well their emotional responsiveness (FC). Several of these characteristics were also found to be typical of the sample in our previous study (Getzels and Csikszentmihalyi, 1964)--compare, for instance, the Rorschach S with 16 P.F. factor Q2 (self-sufficiency), the M score and the 16 P.F. factor M (imaginativeness), or the Y score and the 16 P.F. factor A (social withdrawal).

Relationship between Some Rorschach Categories, and the Process and Product of Discovery

Interpretation of the Rorschach test, as pointed out earlier, is not based on single scores but on the total pattern of responses. It is therefore very difficult to find meaningful correlations between any given score and some other variable. To do complete justice to the Rorschach, its material should be used for individual interpretation. Since such a process would require more time than is now at our disposal, we will limit ourselves to two sets of relationships that hold true for the group as a whole. Table 6.03 indicates that the frequency of percepts scored as "bizarre" correlates negatively with both the indices of discovery, and with the evaluation of the products. The examiner, who analyzed the Rorschach protocols independently of both the process and products raters, scored a response as "bizarre" when it showed "extremes of emotion and illogicality." The interest of this relationship consists in that it should serve to dispel the notion that either the process of discovery or the originality of the drawings, or both, are the product of simply "atypical" behavior, in the deprecatory sense of the word. In fact, we see that originality in the drawings has the highest negative correlation with "extremes of emotion or illogicality." This supports the contention that originality is achieved through a quite controlled process: haphazard ideas do not produce originality. And, as follows from our descriptions of the discovered problem-solving process, success in discovery is antithetical to "scatter-brained" or "irrational" thinking.

The second set of correlations in Table 6.03 illustrates

TABLE 6.03

CORRELATION OF RELATIVE FREQUENCY IN TWO RORSCHACH RESPONSE CATEGORIES, WITH THE DISCOVERY PROCESS VARIABLES AND THE PRODUCT RATINGS (N=28)

	Percentage of Rorschach Responses	
	Bizarre (B) Responses	Light (Y) Responses
Discovery Process Variables		
Problem Formulation (AA)	-.34*	.27
Problem Solution (BB)	-.35*	.09
Concern with Discovery (CC)	-.25	.29
Total Process (ABC)	-.40**	.30
Product Ratings by 5 Artists		
Over-all Aesthetic Value	-.45***	.40**
Originality	-.56***	.34*
Craftsmanship	-.43***	.41**

*p. = .05 **p. = .025 ***p. = .01

the positive relationship with the light (Y) response with the evaluation of the products. The Ss whose percepts include light effects produce the better drawings in the experimental situation. As we pointed out in the previous section, a high frequency of "Y" responses can be interpreted as "anxiety concerning affective needs," and "positive but painful withdrawal." It is particularly meaningful that the two highest correlations of this variable with the discovered process ratings occur with C1, concern with discovery in general (rho = .30), and C3, concern with discovery in the solution of the problem (rho = .42). This seems to suggest that the concern with discovery which these Ss voiced in their interviews might be related to their relative isolation from society at large and its ideals--an isolation that permits them to re-interpret ideas and emotions outside conventions, but which also causes some feeling of anxious loneliness.

CHAPTER VII

RESULTS V: CONSISTENCY OF ARTISTIC JUDGMENTS

When in Chapter IV above we were confronted with the problem of establishing the quality of the artistic products, we resorted to the judgment of a group of independent artists. Table 4.02 has shown that the correlations among the ratings of these five artists were not always high. Although the averaged ratings for the group of judges as a whole correlated highly with the process of discovery (Tables 4.03, 4.05), indicating that the combination of the artists' judgments provides a stable criterion, the relative disagreement among the artists raised a series of questions which we felt needs to be explored further. The present chapter presents both the problem which we felt to be at issue, and the data relevant for its clafification.

The Problem

Perhaps no other measurement of human achievement is so fraught with intrinsic difficulties as the task of assessing artistic creativity. It is a fact well known in the history of art that work deemed excellent by contemporaries often pales with the years, while unrecognized products of a previous age are acclaimed in the succeeding one. As psychologists have realized for some time, aesthetic appreciation--which to a great degree determines judgments about creativity--is heavily influenced by such factors as the personality of the judge (Eysenck, 1940; 1941), his native culture (Lawlor, 1955), his urban or rural status (Subes, 1957), his social class (Frumkin,

1960) and his intellectual sophistication (Knapp, 1960; 1963).

While the above reasons seem to negate the possibility of finding an absolute, universal criterion of excellence for works of art, they do not deny the possibility of obtaining operational criteria with temporal and cultural limitations. As yet we have no means of knowing what the critics may decree about a certain painting two hundred, or even twenty years hence--and perhaps we shouldn't even worry about it too much. One could argue the irrelevancy of the assumption that the judgment of posterity is always more correct than that of the shifting present: the criteria of any age are relative, and "correct" in its context. The consensus of a later age need not supersede that of the past. If we do not think as highly of Raphael as people thought a hundred years ago, this does not detract from his greatness in the nineteenth century, or prevent it in the twenty-first.

But is it possible to find a viable consensus within a limited time perspective? On this score there is surprisingly little evidence in the literature. We do not know much about the extent to which experts agree on the value of previously unknown artists' work-samples. Most studies in this area have dealt with differential preferences of "normal" subjects judging works of already known artists, or with the judgments of teachers rating drawings by school children. In the course of this study we collected some data bearing on this very problem. We had available the drawings of our subjects, many of whom had in fact already achieved some professional distinction.

For the experiment proper, these drawings were evaluated by a number of practicing free-lance artists of established reputation as described in Chapter IV. In addition, the drawings were evaluated by a group of teachers at the School where the subjects were students. We also asked two groups of non-artists of the same sex and comparable age, accomplishment, and cultural environment to judge the drawings. The first non-artist group consisted of theoretical mathematicians, whose vocation can be seen as involving "aesthetic principles," albeit of a non-figurative kind. The second non-artist group comprised business graduates, whose vocation is presumably least similar to that of the artists. The data thus obtained can be applied to the following questions: Is there agreement among the art teachers on the quality of the drawings? Is there more agreement among the artist or the non-artist groups of raters? What is the relative consensus on evaluative dimensions such as Originality, Craftsmanship, Over-all Aesthetic Value? Do the artist and non-artist raters agree on these dimensions? Are there some distinctive patterns in the evaluation of artist ("expert") and non-artist ("lay") raters?

Procedures

Sample

The judges were asked to rate the 31 drawings made under identical conditions by the third and fourth-year male Fine Arts students at the School of the Chicago Art Institute as already described.

Judges

Four groups of five judges each were asked to rate the drawings: (a) Artists. Free-lance artists with established reputation. Each has had several one-man shows; their work is represented in the

Museum of Modern Art, the Library of Congress, the Chicago Art Institute, and galleries across the nation. (These were the artists on whose ratings the results in Chapter IV were based.)

(b) Art Teachers. Full-time teachers of painting at the School where the subjects were students. All the judges were also practicing artists.

(c) Mathematics students. Candidates for a Ph.D. in theoretical mathematics at the University of Chicago.

(d) Business students. Candidates for a Ph.D. in Business or Economics at the University of Chicago.

Ratings

The judges were asked to rate the sample on three dimensions:

(1) Craftsmanship or Technical Control ("regardless of originality");

(2) Originality or Imaginativeness ("regardless of craftsmanship"); and

(3) Over-all Aesthetic Value. If the judges felt this last criterion to be vague, additional clarifications included: "how would you rate these drawings if you were to assign prizes in a show?" and "which of these drawings would you rather own?"--the emphasis being on over-all excellence.

The three dimensions were not further defined, and each judge was told to abide by his own existing opinion as to what the dimensions meant.

The ratings were given on a 1 to 9 point scale with pre-normalized distribution. Thus the judges were to select one drawing to be rated "1" (the lowest on any dimension) and one to be rated "9" (the highest); two each to be rated "2" and "8" respectively; four each to be rated "3" and "7"; five to be rated "4" and "6"; the remaining seven drawings to be rated "5," or average.

Results

Consistency within the groups

The first question is whether the opinion of the five judges within each of the five relatively homogeneous groups is consistent or not. Table 7.01 reports the intraclass correlation coefficients for each group on each of the three dimensions of evaluation. Eleven of the 12 coefficients are significant at the .01 level of probability, indicating that in general there is agreement within all groups. The five teachers are the most consistent group, while the five independent artists show the least consistency--in fact, their agreement borders on the insignificant. A large part of the unreliability in this group, however, is due to the youngest of the five artists, whose ratings were uncorrelated with that of the other four.

TABLE 7.01

AGREEMENT WITHIN FOUR GROUPS OF JUDGES RATING 31 DRAWINGS ON THREE DIMENSIONS, EXPRESSED BY INTRACLASS CORRELATION COEFFICIENTS

Judges	Dimensions		
	Over-all	Originality	Craftsmanship
Artists	.29	.31	.22
Art teachers	.59	.47	.36
Mathematics students	.36	.45	.44
Business students	.34	.35	.51

One noteworthy feature of Table 7.01 is that the agreement on the dimension of technical skill, or Craftsmanship, increases both in relative and absolute value the further the judges are from a total commitment to the arts. Apparently there is more consensus among laymen than among the professionals about what constitutes "good craftsmanship" in art.

Consistency among dimensions of evaluation

Another question that asks itself is, how much are the three dimensions of evaluation related to each other? Table 7.02 shows that in general there is a powerful over-all or "halo" effect in the rating of art-work, so that a drawing rated high on one dimension is likely to be rated high on the other two. The table also suggests that the greater the commitment to art on the part of the raters, the less discrimination among the three dimensions. For the artists, drawings are either good or bad on all three dimensions; for business students, drawings rated high on Originality might be rated low on Craftsmanship or Over-all Value and vice-versa. The relationship between Over-all Value and Originality as rated by the artists is significantly higher than the same relationship for both mathematics and business students. The same trend is further illustrated in Table 7.03, where the partial correlations indicate that for both art groups Over-all Value is more highly related to Originality than to Craftsmanship, while for both non-art groups the opposite is true: Over-all Value is more highly related to Craftsmanship than it is to Originality.

TABLE 7.02

CORRELATIONS AMONG THE AVERAGED RATINGS OF THE THREE DIMENSIONS OF EVALUATION, FOR THE FOUR GROUPS OF JUDGES

Judges	Correlations between:		
	Over-all - Originality	Over-all - Craftsmanship	Originality - Craftsmanship
Artists	.90	.82	.76
Art teachers	.86	.79	.65
Mathematics students	.75	.89	.58
Business students	.64	.80	.53

TABLE 7.03

FIRST-ORDER PARTIAL CORRELATIONS AMONG THE AVERAGED RATINGS OF THE THREE DIMENSIONS OF EVALUATION

Judges	First-order partial correlations between:	
	Over-all Value - Originality (with Crafstmanship held constant)	Over-all Value - Craftsmanship (with Originality held constant)
Artists	.76	.49
Art teachers	.74	.59
Mathematics students	.62	.85
Business students	.43	.71

Consistency between the four groups of judges

The next logical question becomes, how are the judgments of the various groups related to each other? Table 7.04 presents the intercorrelation matrices. The first pattern to be noted is that, as ex pected, the judgments of the two art groups are very similar to each other, and so are the judgments of the two non-art groups.

TABLE 7.04

CORRELATIONS BETWEEN THE AVERAGED RATINGS OF THE FOUR GROUPS OF JUDGES, ON THE THREE DIMENSIONS OF EVALUATION

Judges	Art Teachers	Mathematics Students	Business Students
		Over-all Value	
Artists	.73***	.32*	.11
Art teachers		.43**	.24
Mathematics students			.74***
		Originality	
Artists	.75***	.49**	.54**
Art teachers		.58***	.60***
Mathematics students			.80***
		Craftsmanship	
Artists	.72***	.31*	.25
Art teachers		.35*	.31*
Mathematics students			.70***

***$p. < .001$ **$p. < .01$ *$p. < .05$

An unexpected finding is that on the Originality dimension all four groups tend to agree to a very significant degree. The implication seems to be that the cultural consensus for originality is greater and more deeply rooted than the one for craftsmanship, or for over-all value. It is also interesting to note that despite the lack of agreement within the group of artists, when their judgments are averaged, this composite judgment is quite similar to that of the five art teachers. Perhaps while the independent artists have a more specialized notion of Originality, etc., the combination of these complementary notions adds up to a criterion similar to that of the more consistent teachers.

A correlate of evaluation: Realism vs. Abstraction

Perhaps the most striking difference between the drawings preferred and those rejected by all judges was that the former tended to be more abstract, the latter more representational. The 31 drawings had been previously rated by two non-artists on a continuum of abstraction (rho = .82 on a 4-point scale). Table 7.05 reports the evaluation of the five drawings which both raters placed in the "very realistic" category, and of the five which both raters placed in the "very abstract" category.

TABLE 7.05

AVERAGE RATINGS GIVEN TO "REALISTIC" AND TO "ABSTRACT" DRAWINGS*

Judges	Over-all Value		Originality		Craftsmanship	
	Realistic	Abstract	Realistic	Abstract	Realistic	Abstract
Artists	3.80	5.48	3.70	5.48	4.16	5.24
Art teachers	3.48	6.44	3.32	6.48	4.40	6.12
Mathematics students	3.88	6.04	2.92	6.48	4.28	5.96
Business students	3.88	5.24	3.36	5.80	4.56	6.28

*Mean rating of 5 drawings by 5 judges. Lowest possible mean score: 2.2; highest possible mean: 7.8.

It is obvious that the four groups of judges placed the abstract drawings higher on every dimension. All twelve differences are significant beyond the .02 level by a "z" test. The abstract drawings are especially considered to be more Original than the realistic ones, while the difference between the two types of drawings is least on the Craftsmanship dimension. Furthermore, the realistic-abstract variable influenced the evaluation of the five artists less than that of any other group in eight of the nine possible comparisons. However, the overriding import of the table is the fact that abstract drawings have a much higher chance of being rated higher on all dimensions of aesthetic evaluation than realistic drawings. It is known that children up to about age 14 show a strong preference for naturalistic, representational paintings (Zavalloni and Giordani, 1958; Marchal, 1958), and that less intellectual and sophisticated adults also prefer more representational work (Knapp, 1963). Table 7.05 illustrates rather powerfully the bias for abstraction prevalent in the highest intellectual strata of our society, artists included. It might be added, however, that the drawing that both art groups through best was not among the five most abstract drawings.

Consistency in rating single drawings

For a better understanding of the variables involved in the judgment of art, a more extensive study should be made of the works on which experts and laymen agree or disagree. In Figure 7.01 we present an illustration of four basic patterns of judgment. The drawing of S.01 was the favorite of both art groups, but it was relatively disliked by both non-art groups. The reverse occurred with S.09: his drawing was disliked greatly by the art groups, but liked quite well by the laymen. The drawing of S.05 was liked by all four groups, that of S.04 rejected by all four.

Unfortunately, we lack clear, unequivocal concepts for describing the four drawingss, and consequently for explaining the differences in systematic terms. Perhaps with the wider application of

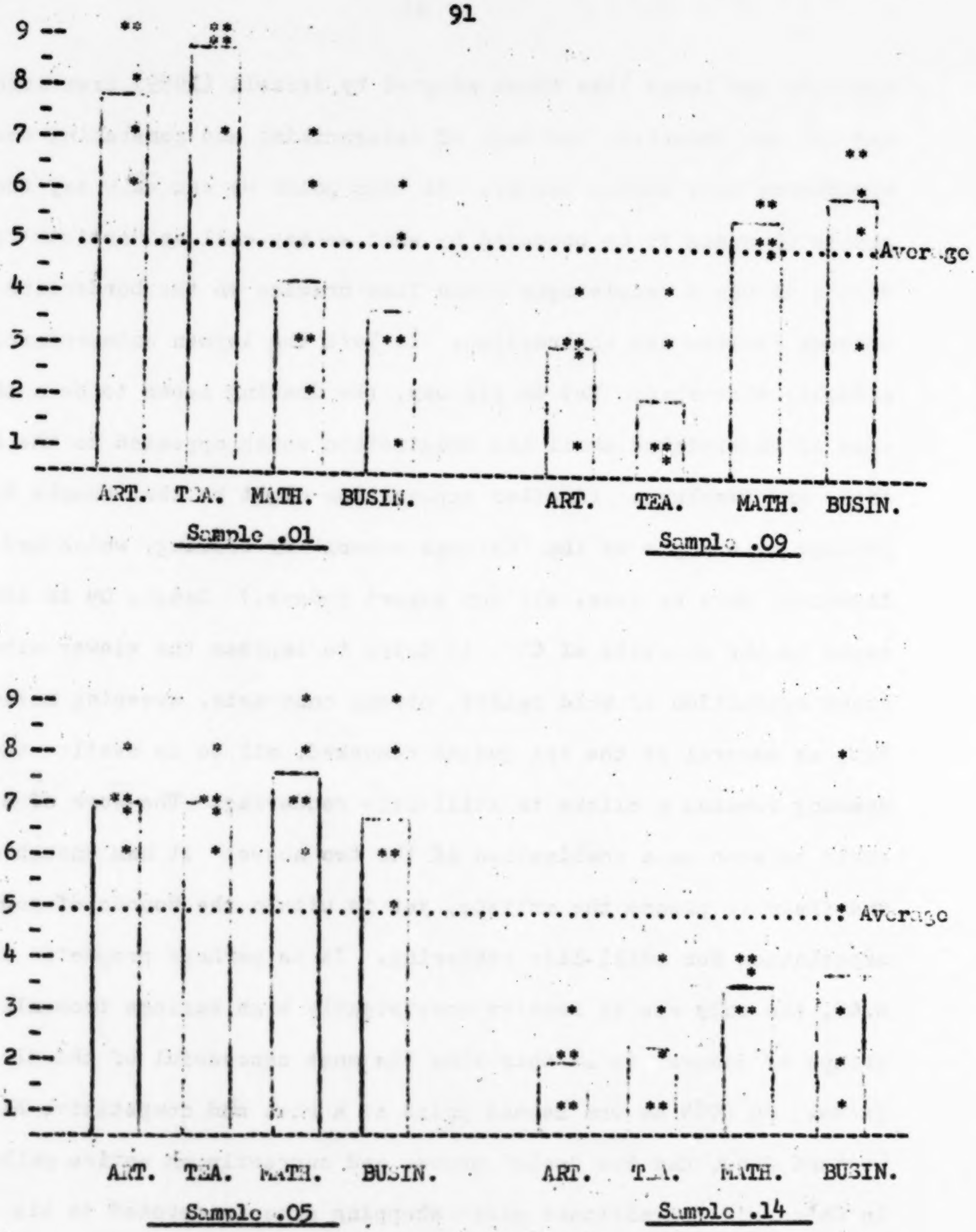

Fig. 7.01.--Over-all Aesthetic Ratings of Four Selected Drawings--an illustration of different patterns of consistency. Each asterisk indicates a rating by one judge.

concepts and terms like those adopted by Israeli (1959) from mathematical set theories, the task of categorizing and generating new hypotheses will become easier. At this point we can only say that sample 01 seems to be produced by what we may call an "artists' artist"; it was a deceivingly bland line-drawing on the borderline between realism and abstraction. It left the laymen unimpressed, or actually disturbed. Yet in its way, the drawing seems to be a showcase of understated skill and imagination which appealed to the artists and teachers. (Another explanation might be that sample 01 is perhaps an example of the "Chicago school" of drawing, which had influenced, more or less, all our expert judges.) Sample 09 in this sense is the opposite of 01: it tries to impress the viewer with a showy exhibition of bold relief, strong contrasts, sweeping movement. But, as several of the art judges remarked, all to no avail: the drawing remains a cliche in still-life rendering. The work of S.05 could be seen as a combination of the two above: it has enough skill and flair to please the artists, yet is within the bounds of popular expectation for still-life rendering. It is perhaps prophetic that S.05, the only one to receive consistently high ratings from all four groups of judges, is at this time the most successful of the 31 subjects. In 1964 he won second prize at a rich and competitive Mid-western Show, had two "solo" shows, and currently an entire gallery in Chicago's "magnificent mile" shopping area is devoted to his work. In contrast to 01, he is "the artist of the hour." Sample 14 on the other hand found no favor with any group. Like sample 09, this is a standard illustration-reproduction, but without the showmanship that in 09 impressed the laymen.

The comparison in Figure 7.01suggests the possibility of using expert and lay raters concurrently, either to separate out from the experts' ratings the effect of popular preference, or to separate out the "in" choice from the popular choice--depending on the purpose of the rating. Thus in one case we might select 01 over 05, since 01 was liked by artists despite its being unfashionable, and might therefore have more real worth and staying power; or we might choose 05 over 01, because it will probably be more successful in the present. In any event, this may be a fruitful appoaoh to studying taste, value, and popularity in art.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Objectives

Three central questions were raised in this study: (a) Could the manifest behavior observed in artistic composition be classified systematically? (b) Could differences among artists in this respect be described reliably? (c) Assuming positive answers to the two above questions, would there be any relationship between these descriptions and (i) the quality of the artistic products, and (ii) selected intellective and personality characteristics of the artist?

For analytic purposes, artistic production was conceived of as discovered problem solving in contrast with the more usual types of cognitive production which may be conceived of as presented problem solving. In the latter, the problem, the method of solution, and the standard for judging the correctness of the solution are previously known. In the former, not only are the method of solution and the solution unknown, but the problem itself needs to be discovered and formulated (Getzels, 1964). The crucial part of the creative process is not problem solving but problem finding (McWorth, 1965). In this sense, an artist's drawing under free conditions may be considered an example of discovered problem solving: the artist must decide what the subject matter will be (envisagement or formulation of the problem), how it will be developed on the drawing board (method of solution), and there is no universal a priori criterion of "correctness" against which to test the particular artistic product (solution).

The present study sought to apply this model of discovered versus presented problem solving to the investigation of the cognitive processes involved in a creative task, i.e., the production of a drawing at the School of the Art Institute of Chicago. Most immediately, it was believed that such systematic exploration might add, however modestly, to our understanding of the cognitive processes involved in creating a drawing; ultimately, it was hoped that the increased understanding of the cognitive processes underlying artistic creation might shed light on the cognitive processes involved in other areas of creative endeavor.

Procedures

Sample

The group under investigation consisted of 31 male third and fourth year Fine Arts students at the School of the Art Institute of Chicago. Many Ss have already achieved the status of "artist" by exhibiting their work in competitive shows and galleries, and by selling to the public.

Procedures

The discovered task.--Subjects were asked, one at a time, to do a drawing in a studio of the school. Twenty-seven objects of various types were available for the Ss to choose from, arrange in a composition, and then to draw. The instructions stressed the point that the objects could be arranged in any way the S wanted, that he could use one, all, or none of the objects, and that the task consisted in its essence in producing a drawing which would be pleasing to the S himself. The Ss activities during the performance of the task--both the preparation of the still-life and the execution of the drawing--were entered in an observational record and analyzed for evidence of "discovered problem-solving" behavior. The drawing as it developed on paper was photographed at 3 and 6 minute intervals.

The presented task.--To measure the Ss' performance in solving a "presented" problem, the Vigotsky Concept Formation test was given. The characteristics of this test are such as to permit comparisons with the solution process of the "discovered" artistic task described above.

The interview.--Each subject was interviewed on a number of the relevant discovered versus presented problem variables. The questions were aimed at securing a subjective account of the process of discovery, that is, the artists' thoughts and feelings in conceiving and executing a work of art.

The Rorschach.--This test was given to 28 of the 31 Ss, in order to explore differences in "perceptual styles" among the artists.

Additional information

Biographical, cognitive, personality and educational data.--For each S, there were on file test results in the following areas: Intelligence (Wonderlic, 16 PF); Creativity (Guilford); Values (Allport-Vernon-Lindzey); Personality (Cattell's PF, TAT); Ratings by teachers; Grades in art; General descriptive information.

Evaluation of the drawings.--The results of the discovered task, that is the drawings produced by the Ss, were rated by five well-known artists on the three dimensions of Craftsmanship, Originality, and Over-all Aesthetic Value. Later the drawings were again rated by three other groups of five judges each, including both individuals who were directly involved in art ("expert judges"), and not directly involved ("lay judges"). These comparative data were used to study the nature and reliability of artistic judgments.

Results

a. A situation was designed in which artists could be observed while at work. The majority of the artists reported that they felt as free in this situation as they usually do when painting alone. Accordingly, it was assumed that what could be observed of the unfolding process in the experimental situation would be analogous with, or at least have a partial functional counterpart in some forms of artistic creation.

b. Thirty-one artists were observed, their behavior recorded, the progress of their work photographed. This material was analyzed in terms of the concept of "discovered problem solving." Six types of behavior were taken to reflect relevant stages in the formulation and solution of discovered problems. It was found that the subjects varied widely in the extent to which they engaged in such behavior. These behaviors, or "process variables," could be reliably scored by naive raters (Table 3.02). While not excessively high, the correlations among the six variables were always positive; the trend suggested that they were measuring a related construct (Table 3.04).

c. The interviews of the artists were analyzed for statements suggesting interest in discovery. The four measures so obtained tended to correlate, sometimes at a very high level of significance, with the behavioral measures of discovery obtained in (b) above (Table 3.04). Thus subjective concern with discovery may be said to be accompanied by discovery-oriented behavior.

d. The total discovery-process score, based on evidence of discovery in both behavior and self report, correlated beyond the .0005 level of probability with the Originality of the drawings produced, as rated by five well-known professional artists. A lower but still very significant correlation was found with the Over-all Aesthetic Value ratings of the drawings, and a barely significant *rho* with their Craftsmanship, or technical control (Table 4.03). Further analysis shows that the Originality rating alone, when the influence of the two other ratings is partialled out, correlates .90 with the discovered-process score. The other two ratings tend to correlate negatively with discovery, once the effect of Originality is removed (Table 4.05).

e. While the discovery-process seems to eventuate in drawings of higher Originality and lower Craftsmanship when Originality is held constant, the presented process, i.e., the usual problem solving of a convergent type, is concomitant with drawings of higher Craftsmanship; and lower Originality when Craftsmanship is held constant (Table 4.05). The pattern suggests that for a work which is both skillful and original, two cognitive processes are needed: that of "discovered" problem solving, to formulate a novel problem and to achieve an original product; that of ordinary "presented" problem solving, to state correctly and solve adequately the technical problems of the task. There must be both "authorship" and "editorship," so to speak.

f. It was found that subjects who had a high discovery score did not differ from those who had low scores on intelligence tests, but they did better on tests of Divergent Thinking, widely used to measure creativity. The "high" subjects tended to be slightly handicapped in the solution of a standard "presented" problem (the Vigotsky test). Neither school grades, number of scholarships, nor creativity ratings given by teachers in school differentiated the two groups. But the "high" subjects had exhibited their work three times more often than the "lows," and their TAT stories revealed higher concern for novelty, discovery, and humor (Tables 5.06, 5.09). Some dimensions of family and social structure showed differences between the two groups; for instance, "high" subjects tended to be oldest sons and come from upwardly mobile families (Tables 5.11, 5.12).

g. Although results obtained from the Rorschach must be viewed with caution because of possible differences between our scoring and the scoring used on the norms against which our results are compared, the following tentative results can be noted: The artists' mean scores on Rorschach determinants differed sharply from the normative data available. The comparisons permit some inferences about the perceptual styles peculiar to artists, and confirm findings about the personality of artists (Table 6.01). A particularly interesting relationship emerged in the negative correlations between the percentage of "bizarre" responses, and the extent of discovery attempted in the problem-solving process, as well as the rated quality of the product (Table 6.03).

h. A replication study was performed to establish the reliability with which the five artists rated the products of the discovered process, that is the finished drawings. It was found that the averaged ratings of the artists correlated in the .70's with the averaged ratings of five art teachers at the school attended by the *Ss*. Lower correlations, but still significant, were found between the two art groups and five theoretical mathematicians; a more tenuous relationship emerged between the two art groups and business graduates. Some interesting patterns appeared in the judgments of art and non-art groups, suggesting the possibility of using joint expert-lay ratings to distinguish between artists who will be immediately successful from artists who will not.

i. From the above findings, the following inferences are drawn:

1) "Discovery" is a useful construct for studying the phenomenon of creativity. It can be used to observe systematically both the subjective, motivational elements in creativity, and the cognitive steps involved in the achievement of a creative product.

2) By the use of the "discovered problem-solving" concept, some of the confusion inherent in such terms as "creative" and "original" is removed. "Creative" is more properly the over-all value judgment of a product, while "original" refers to one quality of the creative behaviors or products. Discovery might then be taken to refer to a motivational state, and to a cognitive logic necessary for the satisfaction of the motives--a necessary, but not a sufficient condition for creativity.

3) The preliminary and partial identification of some elements in the process of discovered problem solving should facilitate the comparative study of actual creative processes across various fields of endeavor. The concept of discovery is both abstract and structured enough to permit meaningful parallels among disciplines.

4) On the basis of our findings, the following complex mental operations are inferred as occurring during the successful envisagement of a discovered problem and its consequent solution:

a) **A large number of problematic elements are considered before the problem becomes structured.**

b) **Either an unusual element is selected as the focus of the problem, or:**

c) **a usual element is selected and thoroughly explored for unusual possibilities.**

d) **After the problematic elements are selected, the problem begins to be stated, and solutions are attempted. It seems important that the problem solver should not view his problem as having achieved structure too early; otherwise the problem fails to develop along original lines.**

e) **During the solution of the problem, the problematic elements lose their accepted interpretation--their structure and symbolic content undergo hitherto unforeseen transformations which recombine into a new meaningful relationship.**

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